ANNUAL REPORT

1953-1954 **Bul. 482**

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

Trustee Committee on Agriculture and Horticulture

	Term Expires
Alden C. Brett, Belmont, *Chairman*	1957
L. Roy Hawes, *Commissioner of Agriculture*	
Harry Dunlap Brown, Billerica	1961
Denis M. Crowley, Boston	1959
Ernest Hoftyzer, Wellesley	1957
Philip F. Whitmore, Sunderland	1955

Experiment Station Staff, June 30, 1954

J. Paul Mather, *President of the University*

Dale H. Sieling, Director
Matthew L. Blaisdell, Superintendent of Farms and Head of Station Service
Margaret H. O'Donnell, Administrative Director
Chester E. Cross, Head, Cranberry Station
John R. Havis, Head, Waltham Field Station
Kenneth W. Johnson, Treasurer
Portia A. Ierardi, Editor
Donald M. Kinsman, Assistant to Superintendent of Farms
Dorothy M. Rose, Secretary

AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

Adrian H. Lindsey, Head
Alfred A. Brown
Bradford D. Crossmon
Robert A. Fitzpatrick
Herbert G. Spindler
Elmar Jarvesoo
Ronald Aines
Clara Sands

AGRICULTURAL ENGINEERING

Herbert N. Stapleton, Head
Irving J. Pflug

AGRONOMY

William G. Colby, Head
Clifford V. Kightlinger
Joseph Steckel
Karol J. Kucinski
Jonas Vengris
Hrant M. Yegian

ANIMAL HUSBANDRY

Victor A. Rice, Head
John G. Archibald

BACTERIOLOGY

Ralph France, Head
James E. Fuller
Warren Litsky

BOTANY

Theodore T. Kozlowski, Head
William L. Doran
Linus H. Jones
W. Henry White

CHEMISTRY

Walter S. Ritchie, Head
Emmett Bennett
Mack Drake
Arthur D. Holmes

THE CRANBERRY STATION

Chester E. Cross, Head
Frederick B. Chandler
William E. Tomlinson, Jr.

DAIRY INDUSTRY

Denzel H. Hankinson, Head
William S. Mueller

ECONOMICS

David Rozman
Ruth E. Sherburne

ENTOMOLOGY

Charles P. Alexander, Head
Arthur I. Bourne
Warren D. Whitcomb
William B. Becker

FEED, FERTILIZER, AND SEED CONTROL SERVICES

John W. Kuzmeski, Head
C. Tyson Smith
Albert F. Spelman
Jessie E. Anderson
*Leo V. Crowley
Bertram Gersten
Mildred Vander Pol
George Caldes

FLORICULTURE

Clark L. Thayer, Head
Harold E. White

FOOD TECHNOLOGY

Carl R. Fellers, Head
William B. Esselen, Jr.
Edward E. Anderson
Irving Fagerson
Leonard Parkinson

FORESTRY

Robert P. Holdsworth, Head

HOME ECONOMICS NUTRITION

Helen S. Mitchell, Dean
Anne W. Wertz
Mary Lojkin
Pearl Kane
Louise P. Guild

LANDSCAPE ARCHITECTURE

Raymond H. Otto, Head

OLERICULTURE

Grant B. Snyder, Head
William H. Lachman, Jr.

POMOLOGY

Arthur P. French, Head
Franklin W. Southwick
John S. Bailey, Cranberry Station
Walter D. Weeks
Grace Upton

POULTRY HUSBANDRY

Fred P. Jeffrey, Head
Frank A. Hays
J. Robert Smyth
Thomas Fox

SHADE TREE LABORATORIES
Malcolm A. McKenzie, Head
Henry W. Gilbertson
Mary M. Hart
Jessie Moline

VETERINARY SCIENCE
Kenneth L. Bullis, Head
Jack Gray
William K. Harris
Glenn H. Snoeyenbos
Henry Van Roekel
Miriam K. Clarke
†Olga M. Olesiuk
Nathan L. Shipkowitz
Leo P. Beninato
Robert A. Bennett
Carl D. Brandt
Iona Reynolds
Charles F. Smyser, Jr.
Domenka Baronoski
Raymond Cormier
Earle B. Crosby
Gertrude R. Jones
Doris Lambert
Frank Lambson
Mary A. Leipziger
Charles L. Merwin
Margaret Mientka
Louis Musante
Carl Peterson
Albert M. Stanley
Thelma Turner

WALTHAM FIELD STATION
John R. Havis, Head
George P. Faddoul, Veterinary Science
Emil F. Guba, Botany,
Robert E. Young, Olericulture
Eugene Gasiorkiewicz, Botany
John W. Mastalerz, Floriculture
Robert Tichnor, Landscape Architecture
Paul Bobula, Landscape Architecture
Franklin Campbell, Floriculture
Clifford S. Chater, Shade Tree Laboratories
Gordon W. Fellows, Veterinary Science
Stephen Fish, Olericulture
William Garland, Entomology
C. Dana Kuhn, Entomology
Joseph Linse, Olericulture
Richard Pasqualone

*on military leave † on leave

CONTENTS

FINANCIAL STATEMENT, 1953-54, UNIVERSITY OF MASSACHUSETTS, AGRICULTURAL EXPERIMENT STATION

	Hatch	Adams	Purnell	Bankhead Jones 5	Bankhead Jones 9b1-2	Bankhead Jones 9b3	Research & Mkt. Title II	Non-Federal Funds	Total
				RECEIPTS					
Received from U.S. Treasury	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$49,846.19	$18,600.00	$4,910.51		$200,054.89
State appropriation								$466,527.59	466,527.59
Special industry								43,559.29	43,559.29
Balance forward								37,956.71	37,956.71
Total Receipts	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$49,846.19	$18,600.00	94,910.51	$548,043.59	$748,098.48
				DISBURSEMENTS					
Personal service	8,700.00	15,000.00	49,120.13	24,755.11	26,306.59	9,889.71	3,463.64	443.626.96	580,862.14
Travel	525.86		1,051.83	398.18	1,898.06	837.77	238.08	8,458.83	13,408.61
Transportation of things	2.01		35.51	36.21	66.06	38.89		2,167.44	2,346.12
Communication service					253.82		55.81	5,336.15	5,645.78
Rents and Utility services								2,226.11	2,226.11
Printing	1,054.25		400.00	250.00	2,102.30	500.00		3,366.35	7,672.90
Contractual services	702.00		506.82	381.22	655.25	2,080.00		6,724.76	11,050.05
Supplies and materials	541.01		2,713.23	2,990.97	9,692.49	2,948.90	58.17	27,022.40	45,967.17
Equipment	3,474.87		5,977.48	7,691.50	8,871.62	2,218.06	5.00	7,555.08	35,793.61
Lands and Structures (Contractual)			195.00	195.00					390.00
Balance forward							1,089.81	41,559.51	42,649.32
Total Disbursements	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$49,846.19	$18,513.33*	$4,910.51	$548,043.59	$748,011.81
									*86.67
									$748,098.48

*$86.67 unexpended and returned to U.S. Treasury

DEPARTMENT OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

ADRIAN H. LINDSEY IN CHARGE

Labor Cost on Retail Milk Routes. About one-half of the retail price on milk is absorbed by the dealer for processing and delivery cost. Because one-third of this price consists of route driver–labor cost, physical characteristics of routes as well as costs and values were analyzed. Correlation attempts were made to determine what elements affected unit costs. This study has been published as Experiment Station Bulletin No. 478.

The typical route, exemplified by a sample of 17 retail routes from the Springfield Market, shows an average of 26 miles traveled a day and 126 truck stops to serve 155.9 customers, of which 29.3 percent live above the first floor. About one-half of the collections are on a weekly basis, and the remainder are on a bimonthly or monthly basis.

The regular driver works 46.3 hours each week (usually a 5-day basis) and the total work hours each week average 55.8 or 8.50 hours per workday per driver.

The load consisted of 516.6 units of which 92.5 percent were milk items (all in quart units), 3.9 percent cream items, and 3.6 percent other items. Regular milk constituted 38.6 percent, and Homogenized Vitamin D milk 34.8 percent of the total. There was an average of 313 units delivered to each customer, and 57.2 units delivered per hour or 3.5 minutes consumed to serve each customer.

Average route value each week amounted to $790.02 (with regular milk at 22.5 cents per quart), and the average unit value was 24.8 cents. The regular driver's weekly wage was $77.99, but the addition of fringe benefits and inclusion of relief driver cost and helper brought the dealer's weekly driver wage cost to $100.26 or 29 percent above the regular driver's weekly wage. Wage costs are equivalent to $1.80 per hour or 12.7 cents per dollar sale. Wage cost per unit was 3.1 cents or 10.4 cents per customer (with the average delivery of 3.3 units per customer).

An attempt to correlate factors affecting cost reveals a definite and significant relationship between cost per units and the size of the customer order. But the units delivered per truck stop showed no significant relationships with unit cost probably because time saved in making fewer truck stops is offset by more step-climbing time in apartment blocks. There is a definite relationship between the cost per unit and value per unit. Further analysis indicated that as value of the unit increased, both labor wage rate per hour and number of units per hour increased. The reasons for this relationship are not clearly evident.

The relationship of miles traveled to cost per unit showed the unexpected results that with increase in distance, driver cost per unit decreased. Cost to serve a customer showed no relationship to miles traveled. However, the relationship of miles traveled to numbers of

customers served per hour did indicate a decline in the number of customers served as miles on routes increased. This indicates that mileage affects time and cost per unit, and suggests that more distant, higher income families have larger orders. This factor offsets the mileage element.

The large influence of difference in size of customer order on cost per unit suggests the possibility of: (1) pricing milk according to size of customer order; (2) shifting from a one- to a two-quart standard; and (3) serving small customers less often, perhaps on a twice-a-week basis.

—H. G. Spindler, Mrs. Virginia Pierce, Miss Mildred Vander Pol, and Mrs. Clara Sands.

Farm-to-Market Bulk Milk Handling. Conversion to farm-to-market bulk milk handling is continuing. This innovation was introduced in Hartford, Connecticut, in 1948 from California where large farms are typical. On the farm, stainless steel tanks replace cans for storing and cooling milk. In transportation, a tank truck instead of 10-gallon cans is used for hauling milk. At dealers' plants, since milk is pumped directly into storage tanks, weigh scales and associated personnel and space may be eliminated.

Every–other–day assembly is a real possibility and may result in reduction in transportation costs. Better milk (lower bacteria counts) is almost universally reported. Weight and test are determined on the farm; this tends to improve dealer–farmer relationships. Less manual labor is involved, and some decrease in weight and test loss resulting from "stickage" may result.

There are many deterring factors and problems. Farmers' investment in cooling equipment is often doubled. Tank costs range from almost $1000 for a 60-gallon size to about $2500 for a 300-gallon unit, and more for larger sizes. Farmers are reluctant to discard their old coolers before the equipment is worn out. Hauling equipment costs much more—often $10,000 to $20,000 for a complete unit; and the hauler must be able to measure, sample, and approve the quality of every tank of milk.

Because tank costs do not increase in proportion to their size, the hundredweight costs are much higher for the small producer than for the large producer. As a result, large producers (with usually 150-gallons or more capacity) have been converting, but only a few small producers have purchased tanks. Only a few hundred (perhaps 2 to 3 percent) of the suppliers of Massachusetts markets are on a bulk tank system.

The transition period involves duplication of hauling, disruption of established routes, and duplication in dealers' receiving operations.

Pricing problems will develop between bulk and can receipts of milk, and the differentials between nearby and distant supplies will probably be changed. If direct haul distance is extended, some country stations may be forced out of operation.

Analysis of factors affecting tank size required by farmers indicates that every-other-day pickup adds about 20 percent cost to the farmer over every-day pickup; adjustment in price may be an offsetting factor.

Greater seasonality in average production on the Boston Market compared to that on the Springfield Market results in about 13 percent higher cost. Increase in average production per year (about 2.8 percent) makes it necessary for the purchaser to anticipate future production increases, and for small producers (less than the 40- or 50-gallon daily average per producer), the limit in tank sizes available severely increases hundredweight costs.

Further work is planned on recommended tank sizes for farmers and on the relative profitability of daily compared to every-other-day pickup.

—H. G. Spindler and A. H. Lindsey.

Intermarket Milk Price Determination. The determination of the level of prices is one of the most baffling, yet one of the most important problems under regulation. A level of prices, providing sufficient but not an excess supply of milk, must be determined not in isolation, but in its relationship to costs, alternatives, competing market area prices, etc. Herein, the attack is at alignment of prices between market areas. Then steps are taken toward basic price level determination by evaluation of the range between manufacturer, producer, and fluid milk prices, and by the supply-demand standard.

Location theory pricing forms a basis for the determination of milk price levels between competitive milk markets. Under this system of price determination, transportation rates and relative distance of supply areas from deficit consuming areas are the cause of market and farm price differences. This system of pricing is closely similar to free market supply and demand pricing: farm prices decline with distance from market, by the amount of the transportation cost; production in the vicinity of the boundaries between milksheds is assumed to flow to the market that offers the highest price at the farm; and a market price is called for which provides just sufficient incentive to producers (in relation to competing market area prices) to provide sufficient but not an excess supply of milk.

The fact that theoretically developed milkshed areas are almost identical to actual Massachusetts milkshed areas and that theoretical price differences are definitely related to actual price differences is proof that the principle, if not clearly defined and delineated, has nonetheless been a dominant force in price determination between markets.

Location does not account for all the price differences between markets. Other factors that probably account for some of the price differences (some of which are readily measurable, others not) are differences in evenness of production, availability of manufacturing facilities and related factors, health regulations, cooperative bargaining power, location differentials, and insufficient incentive to change equipment and established personal relationships.

This standard of pricing forms a means of equalizing returns to producers and costs to dealers between competing marketing areas. Within markets, equalization of returns and equality of product cost to dealers are integral principles that are accepted under both federal and state regulation.

—H. G. Spindler and Miss Mildred Vander Pol.

Analysis of Fruit and Vegetable Marketing in a Consuming Area. During the 1952 and 1953 crop seasons, apple growers took part in a study to develop a method of reporting prices of McIntosh apples at country points. The growers reported extensive sales information on prepared forms for weekly transmittal to this department. The information was used to prepare a weekly price and volume report, which was returned to the growers. Data were obtained on price, volume sold, packages used, types of buyers, market areas, size, color, and condition of fruit throughout the seasons.

Country-point prices reported by growers were compared with prices reported in market news releases. Many wide divergences were noted among prices of apples reported to be of the same quality, sold to he same type of buyer on the same date, and the same type of market and package. In many instances, the storage door price was considerably lower than the price reported at the wholesale market.

During the second season, growers taking part in the study reported a total of 60,000 bushels of McIntosh apples sold compared with 25,000 bushels for the first season.

A report has been published on the first year's experience, and a report covering the entire study is in preparation.

—*R. A. Fitzpatrick, D. J. Steere, and N. J. Pettipaw.*

A Study of Real Estate Taxation Methods, Taxation Reform and the Effects of Such Measures on Farm Income. A nonprobability sample of 80 dairy farms in Hampshire County was selected for analysis of the relationship between land use capability and assessed valuation of the farm land. Although farms in some towns seemed to show an association between capability and valuation, no close or direct association was found among all farms in any given town. Admittedly, location has a direct influence on valuation, and the selected farms were appraised with regard to location factors. Again, the basic lack of association between capability and valuation remained intact. Before publication, a case study of one town will be made to determine the effect of assessment on town revenues according to land use capability.

—*A. A. Brown, R. A. Fitzpatrick, and D. Storey.*

The Structure and Relationship of Freight Rates of Feed to Feed Prices in the East.

Rates on feed are not an entity unto themselves. Feed is but one of the thousands of commodities transported daily by the railroad, and the rates charged for furnishing this service on feed are related to the rates charged for furnishing the service on other commodities.

The relationship is not mathematically perfect. Transportation as we know it is not much more than a hundred years old. The carriers have been much more successful with the development of engineering practices and operating procedures than with development of the techniques and principles of pricing freight. The same may be said of the regulatory commissions under whose serveillance the railroads have operated.

Rates are the fabric of the rate structure, and it is their relationship to one another that gives the structure a particular form. Classi-

fication, i.e. grouping of items according to common transportation characteristics, was recognized as a requisite to rational rate-making prior to the passage of the act to regulate commerce. Uniformity among the carriers east of the Mississippi and north of the Ohio-Potomac was attained in that year (1887).

About that time, the seventies and eighties of the last century, rates on grain (the mixed feed business as we know it is not much more than 25 or 30 years old) were apparently published as either commodity or sixth class. The instability in rates during much of the period prior to 1914 appears to have given slight meaning to the relationship. Currently, the sixth-class rating is 27.5 percent of first. As a result of the numerous percentage adjustments since 1946 and specific maximum provisions relative to grain, commodity rates on that product from a number of selected points in Official Territory indicate a level about a third below that provided for sixth class.

—*A. A. Brown.*

Northampton Egg Market Supply Area. Egg consumption in Northampton (population 29,063 according to the 1950 Census) was estimated at 16,435 dozens per week in May and somewhat less in late summer. Households consumed 11,030 dozens; institutions (hospitals, boarding schools), 4170 dozens; and restaurants, 1235 dozens of eggs per week.

Of the total consumption, nearby producers supplied slightly less than a half or an estimated 7800 dozens per week, and 8635 dozens were supplied by outside sources. Retail egg outlets supplied households mainly and purchased about 59 percent from local producers and 41 percent from outside sources. Restaurants bought 71 percent from local producers and only 29 percent from other sources. The institutions relied on local farms for only 9 percent of their needs.

The eight towns of Northampton, Westhampton, Hatfield, Hadley, Williamsburg, Chesterfield, Southampton, and Goshen in this order made up the main local supply area. Some additional eggs came from Whately, Sunderland, Amherst, Pelham, South Hadley, Cummington, and Easthampton producers. Springfield wholesalers and jobbers provided a large share of the nondirect local supply, serving mainly the egg retailer group. More distant points furnishing larger quantities were warehouses, country receiving points and other suppliers in East Hartford, Boston, New York, and Bellows Falls, Vermont.

Institutions and chain stores were the principal receivers of eggs from relatively distant points. Their combined receipts were about 6000 dozens or somewhat more than one-third of the estimated total consumption. Regulations and size are the principal factors that appear to exclude the institutions as direct outlets for nearby eggs.

—*A. A. Brown and E. Jarvesoo.*

Broiler-Hatching Egg Production Potential. Continuing analysis of the flock data concerning the Pullorum Testing Program, now covering four complete testing years from 1950-51 through 1953-54, discloses a marked decline in the two recent years of the total number of birds tested for pullorum in the state. (The downward trend, however,

in numbers of pullets suitable for broiler-hatching egg production starting with the 1951-52 testing year seems to have been arrested in the last testing year.) Two causes for this change seem possible: (1) the generally unstable broiler market, (2) the uncertainty regarding the demand for white-feathered birds and, related to that, the limited supply of parent stock.

The breeds and crosses in the potential broiler-hatching egg supply flocks have shifted considerably over the past four years. The rapid ascendancy of white-feathered birds (White Plymouth Rocks in particular) has dominated the changing scene. From a comparatively modest aggregate of 75,000 pullets or 10 percent of the potential estimated numbers in broiler-hatching egg supply flocks in 1950-51, the number of white-feathered birds has sharply increased to an estimated 343,000 or 57 percent for 1953-54. Approximately three-fourths of the pullets in the white-feathered category were White Plymouth Rocks in 1953-54. The Dominant White and the group of other white matings each accounted for approximately 11 to 12 percent.

Broiler crosses dominated the over-all broiler-hatching egg supply potential in the 1950-51 testing year with 436 thousand birds or 62 percent of the total estimated capacity. Among the crosses, Rock-Hamps, with 30 percent, accounted for nearly half, and Rock-Reds, with approximately 24 percent, were second in importance. In subsequent years, broiler crosses declined noticeably and accounted for only 228 thousand birds or 38 percent of the aggregate of the estimated broiler-hatching egg production potential in 1953-54. Rock-Reds were first in importance in that year with 9 percent. Delaware-Hamps were a close second with over 7 percent, and Dominant White matings with a slow but steady gain were third with 6.5 percent. A former favorite, Rock-Hamps accounted for less than 4 percent.

The preference of processors is generally assumed to be the cause of the shifts in breeds kept in supply flocks on Massachusetts poultry farms. This has been expressed as a premium of 1 or 1.5 cents per pound over the price paid for colored broilers. The variations in broiler operations on the Del-Mar-Va peninsula probably account for some of the over-all decline in pullet numbers in supply-flocks in Massachusetts. The peninsula has been a major outlet for Massachusetts poultrymen operating broiler-hatching egg supply-flocks.

—*A. A. Brown and E. Jarvesoo.*

Production Adjustments on Representative Massachusetts Farms. Study has been continued on the effect of changing institutional policy, technology, and prices on farm incomes for representative case situations in Massachusetts. Earlier studies of production adjustments in dairy, poultry, and cranberry farming have been extended to include apple production, garbage-fed hogs, and sheep enterprises. The 1953 summer drought renewed interest in feeding adjustments and irrigation possibilities. Changing capital requirements for representative farms and possible aids through incorporation were studied.

1. *Apple Farm Organization and Operation.* Prevailing patterns of organization and operation of five different-sized apple farms have been determined. Operating statements have been established for

these representative case farms ranging from one to five men in the regular labor force. These budgets have served as a basis for determining the effect of timely production adjustments on farm income. Comparative costs of several combinations of fungicidal and insecticidal spray materials were figured for a particular orchard. All spray materials checked by University technicians gave effective control. For an orchard with 1300 trees, possible savings of $1342 in fungicidal materials and $403 in insecticidal materials were indicated in a range of approved combinations.

Other projected adjustments for a representative farm included improvement of quality, addition of a refrigerated storage, addition of an air-blast sprayer, and a shift to retail marketing. Analyzed separately, some of these adjustments, which are commonly recommended, do not pay. For example, an upgrading in quality brought about by increased pruning, thinning, and spraying costs will not pay unless a better market is obtained for the decreased quantity harvested. Improved quality cannot be directly associated with increased returns. The related factors of added cost involved to improve quality, quantity obtained, and probable market price must also be considered.

2. *Costs and Benefits from Cooking Garbage.* A state law, effective January 1, 1954, requires commercial hog producers to cook garbage prior to feeding it to hogs. Passed as a disease control measure, the law directly increases costs to the garbage feeder. However, in areas where cooking garbage has been underway for some time, claims are made that more live pork is produced from a given amount of cooked garbage than from the same amount of raw garbage. Less sickness, less mortality, and more rapid weight gains for hogs are claimed.

To offer hog feeders a guide for figuring whether claimed benefits will offset costs of cooking garbage, a projection was made for a hog enterprise feeding 720 tons of garbage a year. To cook the garbage, an investment of $3410 added $605 to annual overhead and $478 to operating expenses. Growers estimated that additional hired labor would cost $1369. The total increased cost of $2452 amounted to $3.40 a ton of garbage.

The possibility of 60 pounds of live pork from a ton of cooked garbage compared to 40 pounds from raw garbage was accepted. For the above enterprise this meant an additional 14,400 pounds of pork. At pork prices similar to those received by Massachusetts farmers during the past five years, the added income of $2880 more than offset the $2452 of added annual costs. Other garbage feeders will need to adjust the projection to fit their operations.

3. *Earnings from a Supplementary Sheep Enterprise.* In Massachusetts the prices of sheep products reached their peak in the Spring of 1951. Two years later the prices paid had declined 46 percent for wool, 26 percent for lambs, and 49 percent for mature sheep. At 1951 prices, the probable returns of a representative 30-ewe supplementary sheep enterprise were $406. At 1953 prices, the returns dropped to $99. Beginners should check the profitability of a sheep enterprise on a particular farm by comparing likely receipts with added direct expenses. In addition, they should figure possible profits if the same labor and facilities are used for other enterprises. On some farms the resources

involved would not be used for other enterprises, and a small flock of sheep will add to family pleasure and meat supply, even though monetary returns are small.

4. *Labor Requirements for Cranberry Production.* Eleven years of detailed labor records for a representative nineteen-acre cranberry operation have been analyzed. Prior to the study period the bogs had been well established with a complete water coverage system. Bog acreage did not change during this period, and the management had been the same for more than 25 years. Yields varied greatly, from 55 barrels in 1944, when a severe frost almost eliminated the crop, to the bumber crop of 1213 barrels in 1946. The simple average yield of the eleven years was 726 barrels; the median, 705 barrels; and an adjusted average with the low and high extremes omitted, 752 barrels.

Picking labor, averaging close to one hour per barrel over the eleven-year period, indicates a consistent relationship to yield. During the last three years, 1951-53, a mechanical picker was used, and picking labor averaged lower (eight-tenths of an hour per barrel). The total for other bog labor, approximately 3 hours a barrel, showed far less relationship to yield than picking labor. The size and return from the previous year's crop were important factors in affecting the amount of production labor hired. For example, in 1946, when the crop was the largest and the price of cranberries the highest, total labor per barrel, including picking, was a little more than 3 hours. In 1947, the effect of the previous high value crop resulted in 10.13 hours of labor per barrel, of which nearly 3 hours were spent on capital improvements. Labor on improvements and for certain operations including sanding and intensive weed control have a carry-over effect for more than one year. Consideration of these carry-over effects was necessary in subdividing annual labor requirement into thirteen operations.

5. *Culling Cows to Save Hay and Reduce Milk Surplus.* The 1953 drought left many northeastern dairymen short of hay and silage for winter feeding. Still the dairy industry has been plagued with a surplus of products. A proposed solution to both problems is to decrease the total cow numbers by ten to fifteen percent.

When the farmer is short of feed a common but debatable recommendation is that he cull poor producers. Actually, farms hit by drought face an aggravation of an old problem. The easy answer to a short supply of forage is to balance the size of herd to the supply. But does this reduction of the farm business carry over to the rest? Can the hired man or a family worker be released, and will the farm overhead expenses be reduced proportionately? Abrupt changes in part of the farm business may affect the whole farm for several years.

Several alternative adjustments to problems of drought and surplus were projected for representative Massachusetts dairy farms. For example, the effect of culling the five poorest cows, those annually producing an average of 6,000 pounds of milk each, was shown for a 2-man 40 cow farm. Receipts and expenses before and after the reduction of herd were not changed, but net farm income declined $712, from $3778 to $3066. The net income margin was narrowed since the total expenses, including fixed items, declined less than total receipts. This herd reduction would not allow dropping the hired man. Other

adjustments included maintaining the size of the herd by buying hay or other forage substitutes, selling young stock and buying replacements later, or drastically reducing the herd to a one-man business, with either off-farm employment for the operator or dismissal of the hired man. For most of these adjustments it appeared better to maintain cow numbers and buy forage or equivalent nutrients than to reduce the size of herd and build it back later.

Break-even points in terms of an average cow in the herd have little value in culling. Farm expenses cannot be divided equally by the number of cows in the herd and reduced proportionately as cows are culled. For example, labor is expressed as units of men, not in terms of 120 hours per cow. A reduction in herd lessens labor demands but may save no labor expense.

Profitable culling by individual dairymen depends on the use made of the labor, barn space, and other facilities freed by the sale of animals. Merely having more barn space or more leisure does not help meet farm overhead expenses. The money received for culls, which is only an offset to a decrease in inventory, may be spent for family living or used toward replacements. A trade will pay when the added yield of a better cow will more than cover her added costs.

Wide-spread industry culling could lessen a continuing surplus and strengthen prices temporarily. But on individual farms in a competitive industry the gains from herd reductions may not exceed the losses.

6. *Research into Management Problems of Corporate Farming.* The corporate structure of business enterprises in the United States has a growth closely paralleling that of industry itself. Over several generations, the benefits of incorporation have been of proven worth to business ventures, both large and small. Perhaps only agriculture has been slow in utilizing this institution. Here, too, exceptions can be pointed out, such as the structure common among agricultural cooperatives. Also, many food processing and distributing firms are incorporated as are many of the industries offering direct services to farmers. Farmers, in general, have not seen fit to incorporate their producing enterprises. Looking for farms in a list of the State's 40,000 corporations is like looking for the proverbial needle in the haystack.

The corporate structure applied to farms appears to do more toward assuring security to the farm operator and his family than toward increasing farm income. For older farm operators, social security benefits may soon exceed costs of incorporation.

The farm corporation as a threat to the family farm, which is prized so highly in our society, is unfounded. The family farm may actually be perpetuated through the corporate device. The association of corporate farms with large scale farming is not necessarily valid. Empirical research does not establish the generalization that large scale farms are more efficient in production than family farms.

—B. D. Crossmon and R. O. Aines.

Chore Time Efficiency in Massachusetts Pen and Stanchion Type Barns. The loose-housing or pen-type dairy barns enjoy a persistent interest among dairy farmers. A number of old barns are remodelled

into this type, and new ones built each year. In order to clarify the opportunities for labor-saving in pen-type barns, a time-study of the daily chores for five sample pen barns and five sample stanchion barns was conducted. The farms were located in western Massachusetts. In selecting, an attempt was made to obtain groups of relatively comparable efficiency. On the day of study, an average of 33.3 cows was milked, and 6.1 were dry in pen barns; 41.4 were milked, and 6.6 were dry in stanchion barns. Annual production averaged 8344 pounds of milk per cow for pen barn herds, and 9485 pounds per cow for the stanchion barn herds. The average milk production on the day of the study was 29.2 pounds per cow, testing 4.29 percent of butterfat, on pen-barn farms compared to 28.8 pounds of 4.3 percent testing milk per cow on the stanchion barn farms. An average of 23.2 cows in milking age was handled per worker in pen barns as compared to 18.0 cows per worker in the stanchion barn group.

The analysis of the time-study in these two types of barns showed 13.51 minutes of total chore time as an average per day per cow milked in the pen barn group compared to 19.74 minutes per cow in the stanchion barn group. This means a 6.23 minutes or 32 percent saving in chore time of the pen barn average compared to stanchion barn average. In the most efficient pen barn the average total chore time was 10.61 minutes per cow compared to 13.66 minutes per cow in the most efficient stanchion barn of the group. The least efficient average total chore times were 15.96 minutes per cow in pen barns and 24.33 minutes per cow in stanchion barns.

The daily barn cleaning operations seemed to be the most important factor accounting for the saving in total chore time in pen barns. Time for these chores averaged 4.22 minutes per cow in stanchion barns and only 1.20 minutes per cow in pen barns. The saving of 3.02 minutes is equal to 48 percent of total chore-time saving. Two of the stanchion barns had mechanical gutter cleaners. Milking operations, with twice-a-day milking including caring for milk, and preparing and washing milk equipment, averaged 6.48 minutes per cow in pen barns and 9.06 minutes per cow in stanchion barns. The 2.58 minutes saving is equal to 41 percent of the total chore-time saved. All pen barn cows were milked in milking parlors with elevated milking stalls and pipeline milkers that helped reduce the chore-time for carrying milking machines, milk pails, and jugs. It took 22.2 minutes of milking time per 100 pounds of milk in pen barns compared to 31.4 minutes (9.2 minutes more) in stanchion barns. Feeding operations averaged 1.55 minutes per cow milked in pen barns compared to 3.22 minutes in stanchion barns. This was a saving of 1.67 minutes in favor of pen barns or 26 percent of the total net saving. Hay feeding apparently offered the greatest opportunity for chore-time saving.

Periodic chores and miscellaneous chores favored stanchion barns somewhat and reduced the saving by 1.13 minutes in pen barns with operations mentioned above.

—*E. Jarvesoo, R. E. Moser, and L. Gray.*

DEPARTMENT OF AGRICULTURAL ENGINEERING

H. N. STAPLETON IN CHARGE

Thermal Destruction of Bacterial Spores and Heat Labile Vitamins. The thermoresistometer and miniature retort have been employed to study several aspects of the effect of time and temperature on bacteria and food nutrients.

According to a number of tests to verify the accuracy of the apparatus and procedure, when samples of 0.01 ml. are used in the thermoresistometer cups, the lag correction factor is not significant.

The thermoresistometer was used to study the thermal resistance of spores of P. A. (Putrefactive Anaerobe) 3679 when suspended in vegetable products. The purpose of this study was (1) to establish the thermal death time curve for the P. A. 3679 in vegetables (corn, green beans, asparagus, peas, carrots, spinach) at the higher temperatures and (2) to determine whether, as the product is processed, the pH, physical properties, essential nutrients or inhibiting agents change so that the bacterial resistance is also altered. Our results indicate definite changes that alter the thermal resistance of the spores tested.

Preliminary results of a study of the effect of activation time and temperature on counts of spore populations indicate that the optimum temperatures for maximum counts may be lower than the temperatures now being used.

A newly developed positive displacement pump for use with small capacity heat exchangers will deliver a constant flow that is not affected by minor pressure changes. For a metering pump of this type, the rate of flow is variable within rather wide limits.

—I. J. Pflug, W. B. Esselen, T. Miller, and E. Feliciotti.

The Investigation of Low Cost Unit Housing for Poultry. An experimental laying house was operated to determine the effects of high density population, an open front, and a wire floor.

Preliminary results indicate that the wire floor produced a marked decrease in the number of dirty eggs. Foot or leg injuries did not increase significantly.

Hatchability of eggs was not affected. No conclusive evidence was obtained in regard to the relationship of the open front to bird health and production or in regard to the effects of high density population.

A structural testing program is underway to evaluate the strength of new materials and methods of construction in low cost housing.

—A. B. Barton.

Investigation on Mechanizing Cranberry Production. Further efforts to mechanize cranberry production were continued during 1953. A saving in the labor of moving sand on the bog was achieved by providing "flotation" for a tractor trailer. Special 9 by 15 tires allowed the necessary increase, in gross weight, required to move a reasonable volume of sand.

A preliminary design for a cranberry picker was developed, which included delivery of the berries by conveyer to a trailer for bulk handling. In picking operations conducted with the prototype, the machine had a tendency to pull vines. A re-design to eliminate this feature has been made and awaits further tests.

—H. N. Stapleton, C. E. Cross, and F. B. Chandler.

Cranberry Harvesting and Packaging Investigations. One of the sources of high costs in cranberry production is the amount of labor required for the conventional method of cranberry storage in boxes. In an attempt to reduce the amount of labor, two growers were given technical assistance in the installation of bulk type storages, one of which was equipped with a self unloader. Both storages were also equipped with forced air cooling, which removes field heat from the berries at a high rate and thus produces a better quality product.

Favorable results have been reported and will be checked in further field trials.

—H. N. Stapleton and F. B. Chandler.

Refrigerated Fruit Storage. The study of CA (Controlled-Atmosphere) apple storages indicates that a breather bag can increase the rate of oxygen reduction. The breather bag reduces the differential pressure across leaks during temperature cycles, thereby decreasing the oxygen gain of the room. To obtain best results the room must be very tight, and the bag must be connected with a hose or pipe that has a large diameter.

—I. J. Pflug.

DEPARTMENT OF AGRONOMY

WM. G. COLBY IN CHARGE

Competition for Plant Nutrients between Field Corn and Weeds. Plots planted to corn; three common weeds: pigweed (*Amaranthus retroflexus*), crabgrass (*Digitaria sanguinalis*), and barnyard grass (*Echinochloa crusgalli*); and combinations of each weed with corn were differentially fertilized with super-phosphate. The ability of different species to utilize soil phosphorus differed substantially. At low levels of soil phosphate, the pigweed-corn plots produced a good yield of corn. Corn grew well, but weeds produced little growth and therefore did not compete for plant nutrients. At high levels of soil phosphate, weeds grew very well, competed with the corn for moisture and nutrients with the result that corn yields were low. Chemical analyses indicate that weeds were also strong competitors with corn for potassium and nitrogen. The possibility of growing a good crop of corn and weeds by the use of liberal quantities of fertilizer is not promising.

—*Jonas Vengris, Wm. G. Colby, and Mack Drake.*

Chemical Herbicides for Controlling Weeds in Forage Crops. *Weeds in New Seedings*: Preplanting applications of calcium cyanamid and dinitrophenols were effective in controlling weeds common in grass-legume seedings. These materials were particularly effective in controlling chickweed (*Stellaria media*), a weed which is quite troublesome in new seedings in the eastern section of the state.

Rates as low as 300 pounds per acre of calcium cyanamid and 2 to 5 pounds per acre of the dinitrophenols were effective. Delaying the application of weed control materials for several days (4 to 7) after seedbed preparation, gave much better results than applying them at the time of seedbed preparation. This short delay of a few days breaks the dormancy, induces the germination of weed seeds, and renders them very susceptible to the killing action of the chemicals.

Annual Weedy Grasses: Two annual grasses, crabgrass (*Digitaria sanguinalis*) and downy chess (*Bromus tectorum*) are serious weeds in established grasslands and elsewhere. Dalapon applied in August at the rate of 3 to 6 pounds to an acre was effective in controlling crabgrass in seedings of alfalfa and birdsfoot trefoil. No injury to the legumes was observed. Subsequent studies in the greenhouse showed that Dalapon at the rates used did not injure alfalfa and birdsfoot trefoil, whereas Ladino clover and red clover were susceptible to Dalapon injury.

Encouraging results with the control of downy chess in alfalfa stands were obtained with 3 to 6 pounds of Dalapon to an acre and also with Chloro IPC at the rate of 4 to 8 pounds to an acre. Both materials were applied in early spring while the alfalfa was still dormant.

—*Jonas Vengris, Wm. G. Colby, Mack Drake.*

Field Brome Grass (*Bromus arvensis*). Field brome grass is a vigorous growing winter annual well adapted to this region. When seeded in

August or September, it will make a good growth in late fall and resume growth early in the spring.

Plants grow to a height of 3 to 4 feet and produce an abundance of basal and stem leaves. The root system is extensive, forming a dense sod, and by binding the soil protects it against wind and water erosion. Rapid growth, vigor of seedlings, and a well-branched and deeply penetrating root system are the outstanding characteristics of field brome. These features make it one of the most valuable grasses for use when vegetative cover is required to protect erodible land and also to suppress the growth of many undesirable weeds.

Field brome is nutritious and palatable when fertilized adequately, and it can be used for pasturing all types of livestock, including poultry, in late fall until freezing weather sets in. Heavy grazing or ranging will not seriously injure the sod. As a cover crop, field brome should have supplemental nitrogen added for maximum growth as well as for facilitating the breakdown of tough, heavy sod at plowing time.

Four hundred pounds of seed of the grass was produced in 1953 by this department to be used on farms for experimental and demonstrational purposes.

—*Hrant Yegian and Wm. G. Colby.*

Improved Varieties of Orchard Grass (*Dactylis glomerata* L.) The use of orchard grass in combination with legumes, such as Ladino clover or alfalfa, would find more favor with many dairy farmers in Massachusetts if a winter hardy, late-maturing, leafy, and productive variety were available.

Orchard grass is well adapted and is very productive in this region. It is one of the first grasses to start growth in the spring and to continue growth until the first severe frost late in the fall. It will stand heat and drought and produce high-quality summer pasture at a time when most permanent pastures are dormant—a very important factor in favor of orchard grass in grassland farming.

Selection of individual plants of desirable growth-form type is being carried on in an effort to produce a variety of orchard grass that will breed true to the ideal aimed at. One of our recent selections may offer possibilities for isolating a vigorous type, which is relatively homozygous for such desirable characteristics as winter hardiness, late maturity, leafiness, persistance, and sustained productivity.

—*Hrant Yegian and Wm. G. Colby.*

Corn Improvement. Nearly 100 percent of the land planted to field corn in Massachusetts is now planted to adapted hybrid seed corn, because in comparative trials the present hybrids have outyielded the best open-pollinated varieties by 15 to 30 percent. The plants of these productive hybrids are uniform, produce few nubbins, and have few barren stalks, although they are in most instances actually less vigorous than many of the superior plants that are common in the open-pollinated varieties.

Work is in progress to develop early inbred lines of Mass. 63 maturity possessing greater plant vigor and longer ear. It is hoped

that suitable lines with maximum plant vigor and ear length will further increase the yield of shelled corn by 10 to 15 percent per acre.

—*Hrant Yegian.*

Irrigation Studies and Management of Irrigated Soils. This research is designed to determine methods of application and agronomic practices best suited for the growing of various crops using supplemental irrigation. A study of rainfall data indicates that some Massachusetts farmers are subject to drought conditions nine out of twelve years. The 1953 growing season was especially droughty with many fruit, dairy, and vegetable farmers relying on supplemental irrigation to save their crops. The second cutting of alfalfa hay at Worcester County test plots, where proper irrigation and fertilization were used, yielded 12 times more hay than the check plots. Twenty-five percent of this increase was due to fertilizer, and 75 percent to water. Irrigation will not take the place of proper fertilization and good crop management. In trials on pasture plots of alfalfa, Ladino clover, and smooth brome, where controlled grazing was practiced, four irrigations of one-inch application each week increased the grazing yield 81 percent. On another area the third cutting of alfalfa hay was increased about 50 percent where irrigated, leaving a better stand for the following season. When irrigated lightly at the time of seed germination, fall seeding of alfalfa and brome hay produced a stand two to three times as dense as the check plot. The timely irrigation of seed beds during droughty seasons assures proper establishment of new seedings of hay and pasture fields.

The quality and yield of irrigated tobacco were much better than unirrigated tobacco. Too much water applied at one time may prove unsatisfactory, and a windstorm after a heavy application of water may increase the lodging of tobacco. Tobacco growers who irrigated their crop last year were assured top prices and had no problem in selling their product. Collected data indicate that during normal or favorable climatological growing seasons, the response to irrigation, measured in terms of percent increase in yield, is greater than that observed during growing seasons that would be considered droughty, as in 1949, 1950, and 1953.

— *Karol J. Kucinski.*

Farm Pond Investigation. Information is being obtained on the utilization of farm ponds for water conservation, water supply for livestock and farm buildings, orchard and vegetable spraying, irrigation, fire protection, and recreation. The use of commercial fertilizer in the management of farm fish ponds is being investigated in order to see whether the recommendations of Prof. H. S. Swingle of Alabama will apply in our region. Applications of 100 pounds of 7-7-7 fertilizer to an acre at weekly intervals for six months produced a "bloom" (phyto-zooplankton) on pond waters comparable to that produced under more southern climatic conditions. The yield of black bass and blue gills in warm water ponds has, in some cases, been well over 400 pounds to an acre. Fingerling brook trout have adapted themselves during the past abnormally warm and dry season and survived in farm

ponds formerly considered too warm for trout. Tests indicate that present day powerful insecticides and fungicides used by orchardists do not have any poisonous effects on fish after these chemicals have drained through the soil in the orchard into a farm fish pond. The increased interest in the State for farm ponds for irrigation and stock watering has prompted the ASC to make certain payments to farmers to defray part of the cost of construction.

— *Karol J. Kucinski.*

Potato Variety Trials. These trials were made to inform farmers of the varieties that produce best under our soil and climatic conditions. Fourteen varieties of potatoes were tested for comparative yields, habit of growth, and resistance to diseases. The six highest yielding, better known varieties were: Green Mountains—465 bushels; Teton—381 bushels; Pungo—339 bushels; Cobblers—319 bushels; Katahdin—267 bushels; and Chippewa—261 bushels. Of the commonly grown varieties having the highest percent of total solids, used as a measure of quality, Green Mountain, delus, Kennebec, and Cobblers contained 21.1, 20.2, 18.5 and 18.4 percent, respectively. The delus variety has also been found of high quality at other stations, especially Delaware, and has been released by the United States Department of Agriculture as a new variety. Most of the farmers are growing the high producing potatoes, but not necessarily the best quality. Comparative results of similar tests at other stations are published by the Plant Industry Station in their annual report of the "National Potato Breeding Program."

— *Karol J. Kucinski.*

New Strain of Havana Seed Tobacco. A new strain of Havana Seed tobacco was distributed last spring for farmers' use and is being grown in sizable acreage in Massachusetts and Connecticut this summer (1954). The name of this strain of tobacco is Havana T 48.

The strain seems to be very promising. In small plot tests carried on during several years, it produced consistently good yields of tobacco of highly acceptable type and quality on land that was heavily infested with the black root rot organism, as well as on land that was relatively free of the organism. In these tests the tobacco cured very satisfactorily. In commercial tests last summer (1954) the strain produced heavy yields of tobacco whose type and quality were highly acceptable to cigar manufacturers and the tobacco trade in general.

In small plot and commercial tests, Havana T 48 was superior in almost every respect to Havana K_1 and other strains with which it was tested and compared. Accordingly, it seems that Havana T 48 will soon almost completely replace Havana K_1, which has been very acceptable to growers and cigar manufacturers alike and which, during the last few years, has been grown in 90 to 95 percent of the total acreage of Havana Seed grown in Massachusetts and Connecticut.

—*C. V. Kightlinger.*

Preparation of Tobacco Plant-bed Soil. Results of experimental work with tobacco plant-beds indicate that soil preparation is one of the most important operations in the production of plant-beds and

that certain practices are much better than others in the preparation of tobacco plant-bed soil.

The experience of the writer in following these better practices in the preparation of his own tobacco plant-bed soil and careful examination of plant-beds of tobacco farmers who used these practices indicate that farmers can avoid many of their tobacco plant-bed troubles by using the following procedure:

1. Keep the plant-bed soil in good tilth throughout the summer.
2. Fertilize and sterilize the soil during late summer or early fall, usually during September or early October.
3. Use regular 6-3-6-2 tobacco fertilizer at the rate of 100 to 125 pounds per 1000 square feet of soil, and work it well into the soil to a depth of four to five inches.
4. Shortly after fertilization, sterilize the soil properly by one of the methods listed below.
   a. If chloropicrin is used to sterilize the soil, it should be used while the soil temperature is 55° F. or higher (during September).
   b. If methyl bromide is used to sterilize the soil, it should be used while the soil temperature is 50° F. or higher (during September or early October).
   c. If steam is used to sterilize the soil, it may be applied anytime before the soil freezes.

In each case, higher soil temperatures are more effective for sterilization.

5. Work the soil no deeper than three inches in the spring for seeding.
6. Do not apply fertilizer in the spring before seeding is done. (If fertilizer is applied in the fall as recommended, it will supply enough plant food in the spring to grow good tobacco seedlings.)

—*C. V. Kightlinger.*

Source of Phosphate Fertilizer Studies. Field experiments at three locations in the state have received phosphorus from two sources: superphosphate and rock phosphate. The applications made prior to seeding range from no treatment to 2000 pounds of superphosphate and 4000 pounds of rock phosphate to an acre. The yield data from seedings of timothy, alfalfa, Ladino–brome, and alfalfa–Ladino have shown no significant difference in yield of hay produced on the different phosphate treatments. The four-year average yields of 15 percent moisture hay are 8100, 6600, and 4000 pounds per acre for timothy, alfalfa, and Ladino–brome, respectively.

Phosphorus uptake by the crop is not significantly different between the various phosphate treatments. The four-year average phosphorus uptake values were 12.4, 12.3 and 11.0 pounds of phosphorus to an acre for timothy, alfalfa, and Ladino–brome, respectively.

The combination treatment of 500 pounds of superphosphate and 1000 pounds of rock phosphate to an acre has produced nearly 400 pounds more hay in each of the four harvest years than the 1000 pound superphosphate treatment. The results of these forage crop experiments indicate that the combination treatment of superphosphate and

of rock phosphate and the rock phosphate treatments (minimum application of 1000 pounds) have produced equivalent yields of hay with equal phosphorus content when compared with the superphosphate treatments.

—*Joseph E. Steckel and Mack Drake.*

Fertilizer Phosphorus and Availability to Plants. The importance of active aluminum and iron in soils on the fixation of applied fertilizer phosphorus is more fully appreciated as research data accumulate. Chemically, the fixation process involves the formation of relatively insoluble phosphate compounds from the active aluminum and/or iron in the soil and the applied soluble phosphate fertilizer.

In theory, a material capable of combining with aluminum and iron to form a more stable compound than the metal phosphate should appreciably alter the rate of phosphate fixation. This hypothesis was tested in a 3 by 3 factorial greenhouse experiment using three rates of superphosphate (0, 300, and 600 pounds to an acre), and three rates of oxalic acid (0, 240, and 480 pounds to an acre). Wheat, very responsive to phosphate fertilization, was planted as the test crop on the three replicates.

The relative dry matter yield values for the three rates of superphosphate were 100, 124, and 148, whereas the relative amounts of phosphorus taken up by the crop were 100, 118, and 153. Oxalic acid alone did not appreciably influence the yield or phosphorus uptake by the crop (relative yields: 100, 89, and 97; relative phosphorus uptake: 100, 90, and 103).

The combination treatments of superphosphate and oxalic acid produced both yield and phosphorus uptake increases that prove the original hypothesis of an interaction effect. For example, the 300-pound superphosphate and 480-pound oxalic acid combination treatment resulted in a relative yield of 174 and a phosphorus uptake of 162, whereas the relative values of the 600-pound superphosphate treatment alone were 148 and 153, respectively. The presence of the high rate of oxalic acid with 300 pounds of superphosphate was more effective in yield and phosphorus uptake response than twice the amount of superphosphate. The 240-pound rate of oxalic acid with 300 pounds of superphosphate produced a yield response and phosphorus uptake 90 and 88 percent, respectively, of that produced on the 600-pound superphosphate treatment.

—*Joseph Angelini and Joseph E. Steckel.*

The Value of Fungicidal Treatments for Various Forage Crop Seeds. For the past three years trials have been carried out in the greenhouse and in the field on the value of seed treatment in improving the stand and also forage yields of different forage legumes and grasses. The crops investigated have included alfalfa, red clover, Ladino clover, birdsfoot trefoil, smooth brome grass, millet, and sudangrass. Several commercial fungicidal preparations, including Arasan, Panogen, Vancide, Setrete, and Mema, have been tested in these trials.

Field responses from seed treatment the first two years were erratic. Good responses to seed treatment were evident on some plots

with certain species, whereas other plots receiving the same treatment showed little or no response. These results led to the speculation that soil-borne "damping off" diseases are not uniformly distributed over a field or even a greenhouse bench. The disease may be severe in certain small localized areas, whereas other adjoining areas are not noticeably affected. Greenhouse studies in the Winter of 1953 gave support to this hypothesis. Consequently, the plot designs for field plantings for 1954 were drastically revised. Long narrow plots (21 inches by 120 feet) were used, alternating treated with untreated plots. The field results in 1954 were even more outstanding than those previously secured in the greenhouse. Certain irregular, localized areas responded excellently to seed treatment, whereas adjoining areas showed no response to treatment whatsoever. Micro-relief appears to be one important factor affecting the prevalence and also virulence of the "damping off" organisms. Other factors must be operative also, because in the greenhouse trials some areas that were "diseased" for one planting produced perfectly healthy plants in later plantings. Some species and also certain lots of seed gave much better responses to seed treatment than others. Good responses were secured with reed canarygrass, sudangrass, millet, birdsfoot trefoil, and lespedeza. Little or no response has been obtained with red clover, alfalfa, alsike clover, or Ladino clover.

—*Hans G. Joa.*

DEPARTMENT OF ANIMAL HUSBANDRY

VICTOR A. RICE IN CHARGE

A Study of the Mineral Elements of Cows' Milk. A final effort has been made to resolve the difficulties connected in determining minute quantities of arsenic in milk. The project leader has had the collaboration of Mr. C. T. Smith of the Control Service Laboratory. Results have not been clear-cut and are not deemed suitable for publication in a technical article. They did, however, show a definite trend toward increased amounts of arsenic in milk when some of the cows were fed an arsenic supplement (As_2O_3). The average amount of arsenic in nonsupplemented milks from eight cows over a period of four months (December through March) was 1.4 ± 0.4 micrograms per liter, expressed as As_2O_3. The average amount in supplemented milks was 2.7 ± 0.7 micrograms per liter. Although this seems like a considerable increase, not much reliance can be placed on the average results for three reasons:

1. According to statistical analysis, the standard errors are too high for the difference to be significant.
2. Two cows had less arsenic in their milk when the supplement was fed than when it was not.
3. Eight of the 32 monthly samples showed no difference in arsenic content of the milk regardless of treatment.

The differences showed up largely in the second half of the barn-feeding season. This situation cannot be explained on the basis of increased proficiency with the analytical procedure because the samples

were analyzed at random without regard to chronological order. The amount of arsenic trioxide fed was 100 milligrams per cow daily.

The element aluminum is now under investigation. The feeding trials have been completed and most of the samples have been analyzed, but interpretation of results awaits completion of this phase of the work.

—*J. G. Archibald.*

A Study of Quality in Roughage. Work on this project has centered largely around methods for assuring good quality in grass silage, especially with regard to elimination of bad odors. The most outstanding result of the year has been the excellent quality of the silage preserved with sodium metabisulfite. One hundred twenty tons of silage were treated with this chemical, and a close check was kept on dry matter losses, chemical composition, and quality as revealed by odor, consistency, and palatability. Dry matter loss was 11 percent; the pH was low (4.2); volatile bases were low (0.4 percent); lactic acid was unusually high (7.5 percent); and butyric acid content was negligible, (0.7 percent). Odor was excellent (mild and sweet), and the high degree of uniformity in appearance and palatability was evident to all concerned with the project. Of further interest is the high level of sugar in the silage (4.1 percent) and the fact that this excellent quality silage was made from green crops averaging 76.7 percent of water, a level too high for production of good quality silage without a preservative.

One hundred and eleven tons of mixed grasses (some legumes) were ensiled successfully in a trench without a preservative. Success here is attributed to the fact that the material was thoroughly packed with a tractor and that the grass had been wilted to an average moisture content of 64 percent. This silage had a pH of 4.0, a volatile base content of 0.4 percent, and percentages of lactic and butyric acid were 4.6 and 0.6, respectively. The silage was fed to beef cattle, and palatability was fair to good. There was considerable waste due to unavoidable mixture of sand and silt from the sides and bottom of the trench. For this reason it was not possible to arrive at an accurate figure for dry matter losses, but as nearly as could be estimated the losses were from 12 to 15 percent.

A stack silo built of baled green fodder weighing approximately 20 tons was given a trial this past season (1953). The stack was built on June 2 and 3 from 420 bales, 7 tiers high, and was nearly square (19′ by 20′). It was reinforced against collapse with a snow fence, and was covered with a continuous sheet of vinyl chloride plastic large enough so that the edges were recessed into a shallow furrow around the base; the furrow was then refilled with soil to make an airtight seal. A mold inhibitor in the form of a fine powder was liberally sprinkled over the top and sides of each tier of bales as the stack was built.

The stack was opened on October 6, and it was found that, despite all the precautions taken, considerable mold had developed on the entire outer surface and had penetrated into the interior of many of the bales in the outer part of the pile. For about two weeks the silage was fed to the dairy herd and was cleaned up rather well at first. It was

observed, however, that as time elapsed, the quality of the silage became less and less desirable, so much so that the cows were wasting a lot of it. For this reason the last half of the stack was fed to beef cattle and was cleaned up reasonably well by them. Spoilage (not including some trampled and subsequently refused by the beef cattle) amounted to 29.8 percent of the dry matter originally stored.

In fairness, it should be stated that the weather was unseasonably warm when this silage was being fed out, but because of the high dry matter loss and progressive deterioration in quality after stack was opened, it is our opinion that this method of making silage is not satisfactory. If some means could be devised to keep the mass from spoiling between the time the air seal is broken and the silage is all fed out, the method might be feasible. The mold inhibitor was added with this in mind but it did not accomplish the desired result.

A pilot test was conducted in which silage was made by adding sufficient grain to the green crop at ensiling time so that additional grain need not be fed separately when the silage is fed out, at least not for beef cattle. The grain mixture added consisted of a mixture of 9 parts of hominy meal to 1 part of soybean oil meal, which gives a protein level of 14 percent. The rate was 500 pounds of the mixture per ton of green crop. Results were sufficiently encouraging to warrant trying the method on a large scale this year. The product had a pH of 4.6; volatile base content was 0.4 percent; and lactic and butyric acid were 7.2 and 0.6 percent, respectively.

—J. G. Archibald, D. M. Kinsman, and J. W. Kuzmeski.

DEPARTMENT OF BACTERIOLOGY

RALPH L. FRANCE IN CHARGE

Nitrification Studies with Dried Sewage Sludge. Progress reports on this investigation have been made in the last two annual reports. The work has almost been completed, and a journal article will be published soon. The results of the study are summarized here.

Shortage of stable manure has created a wide demand for organic material that may be added to soil. Dried sewage sludge affords a source of such material. Several questions require answers before sludge can be used. The first, safety in regard to infectious microorganisms, has been investigated here and elsewhere. Another question, which has been the objective of this study, is the effect of dried sludge on microbial activities in the soil, with particular reference to nitrification.

During the digestion process in a sewage disposal system, most of the solid matter of sewage has been digested before the sludge is removed from the digestion tank to be dried. The remaining organic material of the sludge is quite resistant to microbial digestion. (However, organic matter added to soil will be attacked by soil microorganisms and digested eventually.) Because of the resistance of the sludge to further digestion in the tank, it appeared possible that the microorganisms engaged in digestion in the soil might need readily available nutrient material and thus utilize some of the soil nitrates. This could cause depletion of nitrates needed by crop plants growing in the soil.

Soil samples were prepared as follows: soil alone and soil with ammonium sulfate, dried blood, and cottonseed meal, each added separately. Duplicate series of samples were prepared with and without added sludge. After appropriate incubation periods, nitrate determinations were made by the phenoldisulfonic acid method. Sludge did not interfere with accumulation of nitrates from the added organic materials. On the contrary, the dried sludge contained some nitrogen which apparently was added to the nitrate realized from the other materials added to the soil. Thus, the results indicate that the dried sewage sludge could be used as a source of organic material in soil.

The sludge employed contained no industrial wastes, the possible effect of which is a separate problem.

—*James E. Fuller.*

Activities of Soil Microorganisms with Relation to the Availability of Phosphorus in Soil. The first part of this study was concerned with the isolation of pure cultures of microorganisms from the rhizosphere areas in soil, and with an attempt to demonstrate the production, by these organisims, of organic acids that might serve as chelating agents, thus making phosphorus available. The production of acids could be demonstrated by pH measurements, but chromatographic techniques failed to show the presence of desirable acids in significant quantities. Any microbial process in soil is a cooperative activity on the part of numbers of microbial types rather than the activity of pure cultures. For that reason, present work is being devoted to produce

acids in soils by adding fermentable materials. Available phosphorus will be measured, and, if results are encouraging, an attempt will be made to determine the organic acids responsible.

—*James E. Fuller.*

Decomposition of Wood Wastes by Cellulose-Decomposing Organisms. Earlier work on this project was reported in last year's annual report. Active cellulose decomposition had been accomplished, but the particular process developed would be of use only in an industrial plant. Recent work has been concerned with composting wood waste. Some results were realized, but the process is slow. Because sawdust and shavings are much in demand for use as they are, it seems useless to consider decomposing these materials. In wooded areas, there are considerable amounts of wood waste as limbs, twigs, and bark that might be utilized in some way. Further work is contemplated with these materials.

—*James E. Fuller.*

Bacteriological Study of Sewage Disposal Plants. In last year's annual report, it was stated that the ratio of coliform bacteria to enterococci in sewage was approximately 13 to 1. Investigations of this kind on waters from the Connecticut River revealed a similar ratio. Because the coliform group includes both fecal and soil species, a ratio of *E. coli* (fecal strain) to enterococci was determined. This study indicated a greater number of enterococci in polluted river water. The results apparently prove the investigator's contention that enterococci are better indicators of recent fecal pollution than the conventional coliform bacteria. This study also indicates a new approach to sanitary bacteriology.

The conventional test for fecal pollution, employing the coliform bacteria, may condemn the use of a river or stream for irrigation purposes on the basis of soil contamination or a very old fecal contamination. The enterococci test, however, indicates recent fecal pollution and corresponds favorably with the conventional test.

—*Warren Litsky.*

Attempts to Improve the Efficiency of Farm and Commercial Vinegar-Making Methods. Determination of Optimum Conditions for the Conversion of Alcohol to Acetic Acid by Acetobacter. It appears possible to increase the production of vinegar by increasing the growth rate of the acetic acid bacteria when specific growth factors are supplied. Once these factors are known, it then will be possible to standardize the production of vinegar.

A study concerning the growth factors, vitamins, and amino acids necessary for the growth of acetic acid bacteria has been made. Data obtained in this laboratory indicate the possibility of commensalism among various species of these bacteria during the process of acetification. This relationship may throw some light on the controversy regarding the usefulness of "mother of vinegar" in the generator. During these studies, it also became evident that an unknown growth factor for these bacteria may be present in yeast, yeast extract, and

yeast autolysate. This is being investigated at the present time in order to identify and characterize the "yeast autolysate factor."

—Warren Litsky and C. L. Goldman, in cooperation with W. B. Esselen, Department of Food Technology.

Effect of Terramycin in Combination with Other Antibiotics on the Fecal Flora. In last year's report, it was stated that a new form of terramycin (amphoteric) could be used for preoperative "sterilization" of the large intestine.

The total count and numbers of streptococci were decreased, and the coliform bacteria were eliminated from the intestinal flora by the use of this drug. However, it was found that the amphoteric terramycin had no effect on the *Proteus* group. In order to decrease the numbers of this group in preoperative treatment, a terramycin resistant strain of *Lactobacillus* was implanted in the intestine with the idea of "crowding out" the *Proteus*. Present data indicate that this is possible. It must be understood, however, that this is the result of preliminary experimentation and must be investigated much further and in greater detail with a large number of patients.

The application of these findings, if confirmed by future investigations, has great importance in the surgery of the large intestine. To decrease the flora of the intestine is to decrease the possibility of generalized peritonitis after radical operations.

—Warren Litsky, in cooperation with J. R. Cohen, Pathology Laboratory, Springfield Hospital.

Methods of Pasteurizing Milk and the Effect of Pasteurization upon Certain Properties of Milk. Equipment has been designed and constructed which will determine the minimum temperature at which milk can be pasteurized continuously, utilizing the principle of heating milk as it is passed through a small bore stainless steel tube. With such an apparatus it is possible to heat milk from room temperature to 205° F. in times varying from 1.0 second to 0.1 second. Data obtained indicate that properties of milk are not sufficiently changed to be detectable by this process. Bacteriological data indicate that pasteurization can be obtained at very short heating time and high temperatures; however, this fact must be investigated more thoroughly before any definite statement can be made.

An attempt will be made to establish the lowest temperature at which milk can be pasteurized continuously. Once this temperature is established, the elimination of the holding time from the pasteurization definition can be considered. A pasteurization process based upon a single standard (minimum temperature) would be easier to enforce, design, and control, and therefore should contribute to safer milk for human consumption.

—Warren Litsky and R. B. Read, Jr., in cooperation with D. J. Hankinson, Department of Dairy Industry.

Fecal Streptococci in Frozen Foods. A bacteriological survey was made of sixty-four samples of commercially frozen fruits, fruit juice concentrates and vegetables. Both coliform bacteria and fecal strep-

tococci were found to be present in many of the samples. The fecal streptococci were found more consistently, and usually in greater numbers than the coliform bacteria.

A comparison was made of the viability of *E. coli* and the fecal streptococci stored at 0° F. for more than 200 days. The numbers of fecal streptococci remained constant, but the numbers of *E. coli* decreased significantly during storage.

Investigations were made on the viability of the fecal streptococci stored at freezing temperatures (0°, −5°, −20° F.) for more than 400 days. The number remained constant during this storage period.

Phosphate-buffered suspensions of *S. faecalis* were shown to be susceptible to destruction by chemical sanitizing agents. Solutions containing 100 ppm. of chlorine or iodine showed a 99.99 percent kill. Quaternary ammonium solutions of the same concentration showed a 98.2 percent kill.

An attempt to decontaminate vegetables inoculated with *S. faecalis* with varying concentrations of chlorine, iodine, and Roccal was unsuccessful.

The use of hot water to decontaminate beans inoculated with *S. faecalis* was successful. A temperature of 88° C. for one minute was sufficient to obtain a 100-percent kill.

Stock cultures of *E. coli*, *S. faecalis* and *S. liquifaciens* survived in orange concentrate stored at −10° F. for a period of 51 days. The fecal streptococci showed no apparent decrease in numbers, whereas the numbers of *E. coli* fluctuated.

Stock cultures of *S. faecalis* and *S. liquifaciens*, inoculated into orange concentrate containing varying amounts of citric acid, showed no significant decrease in numbers after nine days' storage at −10° F. The addition of as much as four percent citric acid seemed to have no effect on the viability of the fecal streptococci.

Bacteria counts, obtained from suspensions of *S. faecalis* inoculated into sucrose solutions varying in concentration from 4.3 to 30 percent, showed no significant differences.

Because of the results of the experiments, it is believed that the fecal streptococci could be used advantageously in preference to the coliform bacteria, as indicator bacteria in frozen foods.

—Edward P. Larkin and Warren Litsky

DEPARTMENT OF BOTANY

THEODORE T. KOZLOWSKI IN CHARGE

Properties and Importance of Some Fungus and Virus Diseases of Carnations and their Control Measures. Seven chemical compounds used for control of Fusarium wilt did not affect the growth or yield of carnation plants. Pentachloronitrobenzene (Mathieson M 275) used at a rate of 54 grams to a square yard was found to be an effective herbicide for the control of *Oxalis repens* Thunb.

Seven antibiotics were used at 1, 3, 5, 10, 20, 30, 60, and 120 ppm. by soaking cuttings overnight. The cuttings were indexed for rooting. Two materials, streptomycin sulfate and terramycin, inhibited the rooting of carnation cuttings: the former, at 10 ppm. and up; the latter, at 60 and 120 ppm.

Continued host range studies of 18 species of plants did not yield a local lesion host for carnation mosaic.

—*E. C. Gasiorkiewicz, Waltham.*

Determination of Fungus and Bacterial Pathogens in Commercial Propagating Stock of Carnations. Culturing of propagating stock is the only definite method of determining the state of health of carnations. Carnation material from 10 sources was obtained and indexed, and percentages from .06 to 38 percent were obtained. Soil pasteurization and fungicide applications of Zineb materials coupled with insecticides have been effective for the maintenance of health in cultured stock plants.

—*E. C. Gasiorkiewicz, Waltham.*

Chemical Soil Treatments for the Control of Carnation Wilt Caused by Fusarium oxysporum f. dianthi. Fusarium wilt is a systemic disease of carnations for which no effective chemical control is known. Resistance is still not present in commercially acceptable varieties. Because the disease can be introduced into steam-pasteurized soil by diseased cuttings, chemical control methods are being tested. The following materials are under test: Mathieson M 275, Crag 974, Vancide 512W, Crag 1182F, Fuller's Soil Treatment, Dithane Z-78, and Crag 531. Applications were given as soil drenches on a bimonthly schedule throughout the warm weather season from May through August.

No complete data are available to date, but no material was phytotoxic. Three bimonthly treatments with M 275 as a specific herbicide for the control of *Oxalis repens* Thunb., an obnoxious greenhouse weed, have been effective for eight months.

E. C. Gasiorkiewicz, Waltham.

Effect of Carnation Mosaic, Carnation Streak, and Carnation Yellows on the Production of Carnation Flowers. The carnation mosaic virus inoculated on Yoder #115 seedling carnations did not affect production greatly. The mean production for virus-infected plots was 222.3 compared to 195.3 for the virus-free plots. In quality, considerable differences were obtained with the virus-free plots having

a mean quality index of 52.21 compared to 36.92 for virus-infected plots. There was no difference in the number of lateral shoots or flower size. The average number of shoots for virus-free and virus-infected plots was three, and the average flower size was 2.5 inches.

The data clearly point out that carnation mosaic virus does not markedly affect yield but reduces quality at least 16 percent.

E. C. Gasiorkiewicz, Waltham.

Properties of Carnation Mosaic Virus. Carnation mosaic is the most common virus in commercial carnations. In continued studies results of spectrophotometric trials using ultraviolet absorption spectra indicated no differences between virus-free and virus-infected extracts of young and old tissue extracts.

Aging *in vitro* trials of Sidney Littlefield variety extracts buffered for pH 7 and allowed to stand at room temperature indicated that extracts were infectious on *Dianthus barbatus* L. after four days.

In clarification tests the mosaic virus was not inactivated in 95 percent ethyl alcohol.

Inoculations on *Dianthus barbatus* L. plants that carried anthocyanin pigments in the stem and petioles gave more critical reactions when infected with carnation mosaic virus.

—E. C. Gasiorkiewicz, Waltham.

Damping-off and Growth of Seedlings and Cuttings of Woody Plants as Affected by Soil Treatments and Modifications of Environment. Work was continued on the vegetative propagation of super or white pine trees, which involved propagation by grafting and by cuttings.

Cuttings of white pine rooted better when taken after January 1 rather than earlier. There was no difference in rooting ability of lateral and terminal shoots. Cuttings from fifteen white pines were rooted in different percentages. Cuttings from one of the best trees failed to root at any time of year. It was possible to propagate this tree by grafting it upon seedling white pines in February and in April. Rooting of cuttings of white pine was improved by treatment with indolebutyric acid and a fungicide, Phygon or Orthocide.

It was found that beach plums may be propagated by root-cuttings, untreated, taken while dormant or from November through March, and planted in a greenhouse, the root cuttings set horizontally or vertically in the rooting medium with or without the proximal end of the root-cutting in the air. Best results were obtained with cuttings from roots of younger rather than older plants.

—W. L. Doran.

Systematology, Ecology, and History of the Monochaetiae and Pestalotiae. After many years a manuscript on this subject is being organized and typed. Study is offered as follows: Introduction; Indefinite Species; Excluded Species; Monochaetia (4, 5, and 6-celled spore forms); Pestalotia (4, 5 ,and 6-celled spore forms); Bibliography; and Index.

—E. F. Guba, Waltham.

Taxonomy, Infection Cycle and Fungicidal Control of Peach Canker Caused by the Fungus Fusicoccum Amygdali. History of peach canker in the eastern United States and taxonomy of the casual fungus have been clarified. Robert's "constriction disease of peach" (Phytopath 30:963, 1940, and 32:335, 1942) is in many respects analogous with our peach canker, but Robert's pathogen is assumed to be *Phoma persicae* Sacc. or a species of Phomopsis, whose perfect stage is *Diaporthe eres.*

Fungus winters in cankers of the preceding season's growth and as incipient infections in bud scales and leaf scars, which take place in October and November and give rise to cankers and pycnidia about the nodes before the blossom period in the following spring. New infections and inoculum are progressive throughout the growing season. Foliage infection is common, but attempts to infect fruit without injury have not succeeded. The perfect stage of the fungus was not found.

Lime sulfur, dichlone, captan, and the thiocarbamate fungicides are toxic to the fungus; wettable sulfur is not. Successful control has been obtained by (1) sanitation and (2) protection of the trees with fungicide from the late dormant season to the end of leaf fall in November. Protection of leaf scars and bud scales with fungicide during the period of leaf fall is very important.

—E. F. Guba, Waltham.

Investigations of Fungicides that Promise Value in Apple Disease Control. Certain known intolerant combinations of superior oil and fungicides were compared at late delayed dormant (April 20) on different varieties of apples. Foliar injury appeared as follows:

Application	Variety	Foliar Injury
Superior Oil and Captan	Baldwin	None
	McIntosh	None
Superior Oil and Phygon	McIntosh	Slight to moderate
	Delicious	Moderate to severe
Superior Oil and Paste Sulfur	Delicious	Moderate to severe
	R. I. Greening	Slight to moderate
	Golden Delicious	Moderate to severe

These treatments injured the spur leaves, but the injury disappeared and became of no apparent significance later.

Captan continues to cause a significant spotting of Delicious foliage. No injury resulted from the addition of copper fungicides to Superior Oil at delayed dormant. Addition of fungicide to water before adding oil was found to be better than the addition of fungicide after adding oil. Two applications of half-strength phenyl mercury gave eradication

of 74 percent of foliar scab in contrast to 96 percent from two applications of full strength. Each in combination with insecticide and other fungicides and contrasts with mixtures without phenyl mercury gave the following degrees of foliar and fruit injury in 1954:

Materials in 100 Gallons Water	Foliar Injury				Fruit Russeting	
	McIntosh	R. I. Green	Delicious	Baldwin	Baldwin	Delicious
1. Lead Ars., Phenyl merc. ¾	+		Tr.			
2. Phenyl merc. ¾*	++		Tr.			
3. Ferbam, Phenyl merc. ½*	Tr.		Tr.			
4. Ferbam alternating with Phenyl merc. ¾*						
5. Tepp and Phenyl merc. ¾	+++		+++			
6. Phygon alternating with Phenyl merc. ¾*						+
7. Glyodin, Phenyl merc. ½*	+	Tr.			++	
8. Captan*						
9. Phenyl merc. ¾*	+++	+**		Tr.	+	
10. Captan, Phenyl merc. ½*	Tr.			+**	Tr.	
11. Lead Ars., Glyodin					+++	
12. Glyodin*					+++	

*With methoxychlor **Some brown frog-eye foliar spots

The succulence of the new growth occasioned by an unprecedented rainfall in May combined with warm temperatures in early June were important factors contributing to foliar injury from phenyl mercury. The schedule of five applications (April 27 to June 1) gave perfect scab control.

—*E. F. Guba, Waltham.*

Breeding Forcing Tomatoes for Resistance to Cladosporium Leaf Mold. The pedigree of our latest tomatoes immune to Cladosporium leaf mold is:

U.S.D.A. 44 B 292=[(Prince Borghese x *Lycopersicon peruvianum*) F_2 x Pan America]

This heterogeneous type after three generations of selecting was outcrossed twice to Improved Bay State. This hybrid is now being grown commercially as Waltham Mold Proof Forcing. It is a larger fruiting type than Improved Bay State and in addition is totally immune to leaf mold. Waltham Mold Proof Forcing (immune) was outcrossed to Waltham Forcing (susceptible), and in the 1954 spring cropping season it segregated 18 percent for susceptibility. Efforts will be continued until the hybrid is stabilized for immunity and best horticultural type; this may mean two or three more generations of cropping and selecting.

Improved Bay State (resistance from *L. pimpinellifolium*) continues to be a popular forcing tomato throughout New England and Canada.

—*E. F. Guba, Waltham.*

Root Diseases of Parsnips and Control Measures. Root diseases of parsnip continued to be identified and photographed. Several varieties from local and foreign seedsmen were planted on two Essex County farms. Variation in their reaction to the "rust" disease was noted. Isolations have yielded a species of Fusarium, Mortierella, and an unidentified fungus. Model, Short Thick, Offenham, and Hollow Crown were badly rusted; Student, All America, Tender and True, and Guernsey were relatively free. Sugar showed a slight to moderate amount.

Dusts of 10 percent Maneb, Zineb, Captan, Thiram and Dichlone were applied to parsnip plots up to early September. Significant control of rot of foliage petioles caused by the fungus *Sclerotinia sclerotiorum* was noted.

Excessive irrigation, poor drainage, low land, and excessive rainfall contributed to serious occurrences of black spot of the roots caused by the fungus *Itersonilia perplexans.* Hilling soil about the parsnip crowns contributed to the control of the disease. Itersonilia black spot and "rust" are the chief problems of major study.

—*E. F. Guba, Waltham.*

Club Root Resistant Cabbage. Dr. J. C. Walker, University of Wisconsin, in 1952 supplied the investigator with seed of three types of cabbage reported to have resistance to club root (*Plasmodiophora brassicae*). Type designated Walker 8351-T considered the most promising in our planting in 1952 showed approximately 14 percent susceptible plants. Of this percentage, 78 percent were slightly susceptible. Resistant plants with good heads were flowered and mass-pollinated. In 1953, approximately 9 percent of the progeny were susceptible and 73 percent produced good firm heads. Progeny resulting from mass pollination of these segregates combining resistance and firm heads are currently being grown for further exploratory effort. The public benefits from this effort can be tremendous.

—*E. F. Guba, Waltham.*

Frenching of Tobacco in a Seed Bed. Nearly 100 percent of tobacco seedlings were found to be frenched at the time for setting into the field. Laboratory tests showed that this soil and the area

surrounding it contained a causal factor, which gave severe symptoms of frenching when the soil temperature was relatively high. Inquiries resulted in the following information pertinent to this particular case. The land had recently been cleared of brush; tobacco had not been grown previously (to the best of our knowledge); the seed bed was started late and had not been heat-treated or chemically treated; the sash was frequently kept tight to hasten growth, which allowed for the accumulation of heat; one report of air temperature over the plants was 110° F. It is believed from laboratory tests that the presence of the frenching factor in the soil plus the containment of heat by poor ventilation caused the appearance of frenching symptoms. Plants from this seed bed produced normal but delayed plants, when set into a regular tobacco-growing area.

—*L. H. Jones.*

Age of Plants in Relation to Frenching Symptoms. When tobacco (Havana Seed) was planted in soil under optimum conditions for frenching, the symptoms became noticeable 11 days after germination, or 15 days from time of seeding. The cotyledons appeared unaffected, but the first true leaves became chlorotic and distorted by cupping.

—*L. H. Jones*

Poorly Drained Soils and Frenching. The frenching factor in soils is closely related to high moisture and poor drainage. However, a completely submerged soil may not carry the frenching factor. Such a submerged soil was available for testing when the college pond was drained in the Summer of 1953. A previous test had demonstrated that the frenching factor was present in the moist soil adjacent to the pond but not in the submerged soil.

Diffusion of Frenching Factor. Although there is some evidence that the frenching factor in the soil is the result of biological activity, no organism has been associated with parasitism and frenching. That the frenching factor is diffusable was demonstrated by growing tobacco plants in sand over a frenching soil. The water utilized by the plants was obtained by applying water through an opening of the sand to the soil below. By capillary action the sand obtained its moisture from the soil, and since the plants frenched, it is assumed that the frenching factor diffused with the moisture movement because no roots from the plants in the sand were penetrating the soil.

—*L. H. Jones.*

Availability of Chelated Iron in Nutrient Solutions. Chelated iron furnished by several chemical companies gave a marked increase in growth of corn in a nutrient solution when compared with the mineral sources of iron from ferric phosphate and ferrous sulphate. The chelating agent, sodium ethylene-diaminetetra-acetate, will dissolve a suspension of ferric phosphate. Yet, when this sodium salt is used in nutrient solutions containing either ferric phosphate or ferrous sulfate, a toxic factor develops instead of bringing about a greater availability of iron.

—*L. H. Jones.*

DEPARTMENT OF CHEMISTRY

WALTER S. RITCHIE IN CHARGE

Cation Exchange of Plant Root Colloids as Related to Cation Uptake. There is a theory that colloids with high cation exchange capacity bond Ca^{++} and Mg^{++} with much greater energy than K^{+} and that low exchange colloids bond K^{+} with greater energy than Ca^{++} and Mg^{++}. Plant roots contain relatively large amounts of organic colloidal materials with cation exchange properties. It is reasoned, therefore, that plant roots with high cation exchange capacity would attract the divalent cations Ca^{++} and Mg^{++} with greater force and would be expected to adsorb Ca^{++} and Mg^{++} into the plant in relatively greater amounts than the monovalent cation K^{+}. Conversely, low cation exchange roots would attract K^{+} with greater force than Ca^{++} and Mg^{++}. Thereby, plants with low cation exchange roots may be able to adsorb adequate amounts of K^{+} from relatively low levels of exchangeable soil K^{+}; however, high exchange capacity roots would be unable to obtain enough K^{+} from this low level of exchangeable soil K^{+}. Plants with low cation exchange capacity roots would be expected to adsorb relatively more K^{+} than Ca^{++}. Cation exchange capacity of root colloids of different plant species are being studied to explain (1) why there is a differential mono/divalent cation uptake by different plant species, and (2) why higher levels of available potassium are required in the soil for optimum growth of certain plant species than for others.

Cation exchange values were determined for the following species this year: head lettuce 65 me/100 grams (milliequivalents per 100 grams dry roots), cucumber 54, carrot 52, red beet 51, muskmelon 48.6, celery 47, squash 40, potato 38, tomato 35, cabbage 34, onion 29, sweet corn 16, Bermuda grass 10.

In general, one would expect higher levels of available soil potassium per unit of dry weight produced to be required for head lettuce, cucumber, carrots, beets, muskmelon, or celery than for tomato, cabbage, onion, or sweet corn. On light-textured soils it is reasoned that more frequent side-dress applications of potassium would be required for plants with the higher cation exchange roots than for those with low exchange roots. Bermuda grass should be able to survive and produce dry matter at a very low level of available or exchangeable soil potassium. At this low level of available soil potassium, lettuce, cucumbers, potatoes, cabbage, and sweet corn could not survive.

—*M. Drake, J. Vengris, and D. H. Sieling.*

Yield, Vegetative, and Chemical Composition of Forage Crops as Affected by Fertilizer Treatments. Massachusetts soils are low in natural fertility. Large amounts of fertilizer and lime must be applied to supply the high fertility requirements of and removal by high-yielding forage crops. Lime and phosphate fertilizer should be applied before seeding. When superphosphate fertilizer is mixed in the soil, the soluble phosphorus combines with aluminum and iron of the soil. This combination of phosphates with aluminum and iron

greatly reduces the phosphate availability to plants. Applied phosphorus fertilizer may be kept more available by mixing it with manure, which is to be spread on the soil, or by placing the phosphate fertilizer in bands just before seeding. Very little phosphorus applied as annual top dressings of soluble phosphate fertilizers moves into the soil because it rapidly becomes "tied up" (fixed) by aluminum and iron. Phosphorus in the soil surface may encourage shallow root development and thereby reduce the ability of the plant to produce in dry weather. Therefore, because of the inability of top-dressed phosphorus to penetrate the soil, enough phosphorus to supply the perennial forage plant's needs for 4 to 6 years should be applied just before seeding. From 500 to 1000 pounds of 20 percent superphosphate (100 to 200 pounds P_2O_5 to an acre) are required on most Massachusetts soils at the time of seeding.

In contrast to lime and phosphorus, potassium fertilizers should be "spoon fed"; that is, relatively small amounts (50 to 100 pounds of K_2O to an acre) should be applied after each cutting or grazing. Small applications after each harvest are required to prevent unbalanced or luxury consumption of potassium by the plants and to insure an adequate level of available potassium for both legumes and desirable grasses throughout the growing season.

Total yield responses of four-year stands of superior forage species to potassium fertilizer (nitrogen, phosphorus, and lime adequate) are listed below.

	Years	0 lbs. K_2O/a	750 lbs. K_2O/a	Lbs. hay/100 lbs. K_2O
Ladino clover	4	5,600	13,500	1,050
Orchard grass	4	12,650	25,200	1,670
Smooth brome	4	16,100	26,200	1,340
Timothy	4	18,560	28,840	2,055

Phosphorus was applied at the rate of 500 pounds of 20-percent superphosphate in bands before seeding. No additional phosphorus was supplied. The potassium was applied as muriate of potash (KCl) at the rate of 100 pounds of K_2O to an acre after each harvest the first harvest year and at the rate of 50 pounds of K_2O to an acre after each cutting, in the following years.

These yields show the large yield potential of these superior forage species and show the necessity of applying 50 to 100 pounds of K_2O to an acre after each harvest. We have not been able to maintain stands and to produce yields of this magnitude on a field basis. Harvest management factors are believed to limit seriously the longevity of stand and yield of these superior forage species. Plans are being made to study the effects of harvest management factors on yield and longevity of these and additional superior forage species. These factors include soil loading by harvest equipment, height of stubble cut, and time of cutting.

—M. Drake and Wm. G. Colby, in cooperation with the Departments of Agronomy and Chemistry.

Germination of Seeds Removed from Mature and Immature Butternut Squashes After Seven Months' Storage. Germination tests of seeds removed from mature and immature Butternut squashes were made after 211 days of storage. At six intervals during storage the ratio of the weight of typical intact squashes to the weight of their seeds was determined and found to be consistent. At the conclusion of the storage period 100 seeds from mature squashes weighed 10.90 grams compared with 8.9 grams for similar seeds from immature squashes. In the laboratory test, 97 and 77 percent of the seeds from the mature and the immature squashes, respectively, germinated. Of the seeds planted in sand beds heated to 27° C., 99 and 97 percent of the seeds from the mature and the immature squashes germinated, and the seedlings from those seeds weighed 71.6 and 69.1 grams, respectively. These data indicate that by careful selection it is possible to secure good germination of fresh seed removed from immature Butternut squashes after seven months of storage. However, to obtain a bountiful crop, squash seeds should be treated to eliminate seedborne diseases, and the seeds should always be planted on fresh land.

—*Arthur D. Holmes.*

Effect of Storage on Butternut Squash and Its Seeds. The composition of mature and immature Butternut squashes and their seeds during winter storage was studied. The edible portion of typical squashes and their seeds was assayed for water, protein, fat, total sugars, starch, and carotene. Assays were made at six intervals during a 221-day storage period. The amount of water and protein, except for the final assay, remained fairly constant for both mature and immature squashes throughout the storage period. Total sugars and carotene increased, and starch decreased for the edible portion of both mature and immature squashes during storage. The ratio of weight of seeds to the weight of intact squashes for both types of squashes remained fairly constant throughout the experimental period. The amount of water in both groups of seeds decreased as the length of storage increased.

There was about five times as much protein in the seeds as in the edible portion of the squashes from which they were taken. The seeds from the mature squashes contained 34 percent fat; those from the immature squashes, 31 percent. Both groups of seeds lost total sugars, starch, and carotene during storage.

—*Arthur D. Holmes, Albert F. Spelman, and Robert T. Wetherbee.*

Composition of Butternut Squashes from Vines Treated with Maleic Hydrazide. Butternut squash vines were sprayed with 0.05 and 0.25 percent solutions of maleic hydrazide 10 and 20 days before harvest. Typical squashes from the two control and the four experimental groups, taken at harvesttime and after 95 days of storage, were assayed for water, protein, total sugars, starch, and carotene. The results of the assays did not show any consistent effect of the maleic hydrazide treatment on the water, protein, and total sugar content of the squashes. The rate of conversion of starch to sugar and ultimately to carbon dioxide and water was slower for squashes

from the treated vines. Considered on a dry weight basis, the protein, total sugars, and carotene content of the squashes increased during winter storage; the starch content decreased very materially.

—*Arthur D. Holmes.*

Value of Maleic Hydrazide as a Plant-Growth Regulant. Various investigators who have studied the value of maleic hydrazide as a plant-growth regulant caution that the results that may be obtained by the application of maleic hydrazide to various types of food-producing plants are likely to be significantly influenced by numerous factors, such as concentration of the solutions used, the type of plant, the stage of development at the time the spray is applied, the amount and type of fertilizer used to feed the plant, the nature and condition of the soils on which the plant is growing, and such climatic conditions as the atmospheric and soil temperatures, the amount and distribution of rainfall, the relative humidity, and the amount and distribution of bright sunshine.

The consuming public, naturally, will be very much concerned with the possibility of any toxic effects developing from the use of maleic hydrazide. White has reported that maleic hydrazide is not toxic by oral ingestion in amounts likely to be found on plants, but Darlington and McLeish conclude their report of the action of maleic hydrazide on plant cells with "Since nearly all chromosome-breaking agents have so far proved to be cancer-producing as well, we must hope that the agricultural use of this new agent will not be encouraged befor suitable tests are made." The general conclusion that may be drawn from the reports in the literature is that under many agricultural conditions maleic hydrazide offers considerable promise for regulating the rate of growth and development of a number of important food crops.

—*Arthur D. Holmes.*

The Production of Holocellulose from Nonwoody Plant Tissue. Holocellulose properly prepared is good starting material for the investigation or determination of hemicelluloses. When prepared by the chlorite method, holocellulose is usually isolated prior to the extraction of hemicelluloses. However, in routine tests where the extent of control is known, it is often highly desirable to omit the isolation. In these instances the excess chlorite may be destroyed, thereby permitting hemicelluloses to be extracted directly, thus avoiding the possibility of losing some of the more soluble fractions. Although water and/or dilute alkaline solutions are usually used for extraction purposes, solubility may also be effected in solutions of perchloric acid. The carbohydrate content of the extracts may then be estimated colorimetrically by the use of Anthrone. The similarity of the products obtained by the various solvents has not been ascertained.

Lignin is considered to be the only general plant constituent whose quantitative determination is based on resistance to the action of cold 72 percent sulfuric acid. Cranberry pulp, however, contains a substance which falls in this class. The residue may amount to 30 to 50 percent of the cellulose. The hydrolyzed cellulose contains some

products not yet identified. The hemicellulose seems to consist of arabinose and xylose only.

A simple test for quality in hay has been developed. The method is based on the extent to which light is transmitted by a water extract of the hay. The test has been positively correlated to a highly significant degree with high protein and ash content and low fiber content in hay. The results obtained by this test have been confirmed by feeding trials for milk production with several lots of hay.

—Emmett Bennett in cooperation with J. G. Archibald of the Department of Animal Husbandry.

Nature of Winter Hardiness in the Raspberry. (See Department of Pomology.)

The Spectrophotometric Characterization and Estimation of the Constituents of Certain Naturally Occurring Substances with Special Reference to the Carbohydrates of the Plant Cell Wall. Primarily, our objective is to be able to indicate qualitatively the composition of natural products of a carbohydrate nature. The spectrophotometric investigation is in the ultraviolet range. Pure sugars separately in the presence of sulfuric acid behave in a specific manner. However, when the sugars are present as a mixture, the data obtained are not yet of value for purposes of identification.

—Emmett Bennett.

THE CRANBERRY STATION

EAST WAREHAM, MASS.

C. E. CROSS IN CHARGE

The 1953 cranberry crop on the State Bog was 800 barrels, slightly above its 44-year average. The crop was hurt slightly by June drought (.29 inch of rain) and by the failure of adequate pollination. The Massachusetts cranberry crop at 710,000 barrels was by far the largest in history, more than 16 percent over the previous record crop of 1950. The significance of this large crop is more easily grasped, when it is realized that the crop was produced on essentially the same acreage that has been producing since the war. A combination of favorable weather conditions, prompt and careful irrigation, prompt and adequate insect and weed control, and the use of fertilizers has succeeded in raising substantially the crop per acre. Some other cranberry-producing areas still far exceed the per-acre crops of Massachusetts, but it is encouraging to see the local increase in 1953.

The national crop was also the largest in history, at 1,230,000 barrels, and was the first to exceed the million-barrel mark. This huge crop created several tensions in the cranberry market, which resulted in a considerable realignment of marketing agents. At this time, about 1,000,000 barrels of the 1953 crop have been sold.

—*C. E. Cross.*

Weather Observations and Frost Forecasting. Daily readings of weather phenomena were made throughout the year in cooperation with the U.S. Weather Bureau. A drought warning was issued in mid-June, 1953, and growers quickly responded with flash-floodings, portable and permanent sprinklers, and ditch irrigation. State Bog rainfall amounted to only .29 inch in June, 1953. Another warning was issued January 11, via newspapers, to warn growers of oxygen deficiency hazards after snow fell on the ice-covered bogs. There was widespread pulling of the winter flood from under the ice and snow as a result of this warning. The hazardous condition prevailed for 14 days after the warning.

The frost warning service has functioned smoothly during the last year. The Cranberry Station and the Weather Bureau at Boston cooperated to formulate the warnings, and the Cape Cod Cranberry Growers Association sponsored and payed for the telephone service. During the Fall of 1953, 197 subscribed to the telephone warning service, and this spring the number has risen to 212, the largest list since 1949. During the Fall of 1953, 9 warnings were issued for frosts on 6 nights. On September 23, about 2000 barrels were frosted on inland bogs, a temperature of 16° F. being reported from Greene, Rhode Island. Slight damage was also reported from widely scattered bogs on the nights of October 8 and 13.

During the Spring of 1954, 12 warnings were issued on 7 nights. Because of rather consistent subnormal temperatures and excessive cloudiness and precipitation, no measurable frost injury has been re-

ported. Yet, on several nights the minimum temperature was within one degree of the tolerance of the vines. On the night of April 3 a temperature of —5° F. was reported from Foxboro. That same night many bogs survived temperatures of +3° to +12° F. (State Bog) without water protection and without measurable bud injury.

The Station staff is engaged in testing a new formula for forecasting minimum cranberry bog temperatures, a formula that is based solely on local data, and which if proved would enable a grower with wet and dry bulb thermometers and a table for ascertaining dewpoints to compute his own expected minimum temperature. Since, on most frosty nights in spring and fall, the minimum temperatures vary considerably from bog to bog, it is hoped that this new technique will result in a considerable refinement of cranberry frost warnings.

—C. E. Cross, G. B. Rounsville, J. R. Beattie, and H. J. Franklin, Emeritus.

Cranberry Disease Investigations. Dr. H. F. Bergman, Senior Pathologist, U.S.D.A., retired on September 1, 1953. He has since been appointed a voluntary collaborator of the U.S.D.A., and despite his retirement still assists on disease studies. A new station pathologist will be appointed October 1, 1954. Field studies have, in the meanwhile, been considerably curtailed.

On April 1, 1953, the following preliminary keeping quality forecast was issued by Extension Service flash card: ". . . . weather data through March 31 indicate that the general keeping quality of the Massachusetts cranberry crop for 1953 will be fair." On June 8, 1953, the following final forecast was issued: ". . . weather data through June 5 indicate that the general keeping quality of the Massachusetts cranberry crop of 1953 will be only fair."

Growers who held the flooding water late as a result of the preliminary forecast harvested heavy crops of extraordinarily sound fruit in the Fall of 1953. Growers who drained their bogs early and applied fungicides as recommended in the summer harvested fair to good keeping berries. Growers who drained bogs early and used no fungicide treatment generally picked fair to very poor fruit, amply justifying both quality forecasts.

—C. E. Cross, J. R. Beattie, G. B. Rounsville, and H. J. Franklin, Emeritus.

Weed Control in Cranberries. Experiments designed to find a one-spray killer of brambles (*Rubus* spp.) have been continued, so far without adequate success either as a selective treatment in cranberry vines or as a nonselective application. Last year single sprays of ammate with detergent on 35 acres of bog killed all vines and burned off blackberry tops for the season, but apparently all blackberry roots produced new tops this spring. Similar regrowth was noted after single treatments with amine brush-killer in water. Using sprays of 1800 and 2000 gallons of kerosene to an acre in November, 1953, on unpicked cranberry vines, little or no injury was caused to vines, but all small brambles were killed or appeared so as late as June 20, 1954. This treatment is expensive especially because at least one crop is lost.

Nearly all brambles were killed by a kerosene spray of 800 gallons an acre, followed four days later by one of 500 gallons an acre of Stoddard Solvent in mid-May. This ruined the crop prospect but did not otherwise injure the vines.

Half and half mixtures of Stoddard Solvent and kerosene at 600 gallons an acre proved so effective a selective control for loosestrife (Lysimachia) that it was made a standard recommendation this year and growers used about 65,000 gallons in their weed control work.

Tests in July, 1953, with the butoxy-ethanol ester of 2,4,5-T at 250-500 p.p.m. killed nearly all poison ivy, the 1953 crop, and the prospects of a crop in 1954, with some rather slight vine damage. Several growers are pleased enough with this test to give it large-scale commercial trial in the Summer of 1954.

Initial tests with dalapon last fall showed prohibitive vine injury at rates of 10 pounds or more per acre with only indifferent perennial grass control. Results this spring are incomplete but thus far startingly different, for vine injury appears only slight at 20 pounds an acre, and the control of perennial rice cut-grass to date appears almost complete.

The 60-day summer flood, now in regular use for the control of root grubs, was observed last year to give more than 90 percent kill of both blackberries and morning glory. For reasons that are still obscure, asters appear to become even greater nuisances than usual following the "grub flow" or even "late-holdings" of the winter flood.

Intensive study is in progress with amino-triazole, 2,4,5-T, 2,4,5TP, CMU, and various fractions of kerosene. Some work is also in progress with aircraft applications of hormone weed-killers on flooded bogs, the purpose being to apply the herbicide selectively to weeds that have grown above the water level, at the same time using the flood to protect the cranberries.

—C. E. Cross, G. B. Rounsville, I. E. Demoranville.

Soil Water Studies. Perforated plastic tubing has been pulled into the soil for drainage. With little damage done to the vines, this is a very promising way to drain bogs. Plans have been made to place the tubing in similar to the method of putting telephone cable below the ground.

—F. B. Chandler.

Salt in Cranberry Soils. A drainage system has been put in one of the bogs troubled with salt to see whether the damage from salt can be decreased with different water management.

—F. B. Chandler.

Fertilizer Studies. Urea and Uran 32 have been applied with dieldrin for the control of root grubs and nitrogen fertilization with satisfactory results so far.

—F. B. Chandler and W. E. Tomlinson, Jr.

Cranberry Breeding. The sixteen selections of cranberries have been distributed from Marston Mills, Mass., to Holliston, Mass., in

randomized blocks at twelve different locations. This distribution should permit good evaluation of the selections.

—F. B. Chandler and H. F. Bergman in cooperation with U.S. D.A.

Injurious and Beneficial Insects of the Cranberry. Prevalence of Cranberry Insects in the 1953 season. The majority of the insects affecting cranberries were light to normal in abundance during the 1953 season. The most important features of the season were the marked decrease in abundance of cranberry scale generally and the tremendous increase of blunt-nosed leafhoppers on several bogs.

Plots sprayed for root grubs during the Spring of 1953 have been kept under observation. Granulated formulations of chlordane at the rate of 10 and 20 pounds to an acre and of heptachlor, aldrin, and dieldrin at the rate of 5 and 10 pounds to an acre have not been effective even after a year. Emulsion formulations of heptachlor, aldrin, dieldrin, endrin, and isodrin at the 10-pound-per-acre level have given almost perfect control in all plots, whereas at the 5-pound-per-acre rate, while there is some survival, the population has been greatly reduced.

Chlordane applied in emulsion form at 10 and 20 pounds per acre produced no mortality during the 1953 season. However, dead and sick grubs have been common in these plots during May and June of 1954.

Results to date indicate that post-harvest applications of dieldrin are effectively controlling root grubs. Dieldrin 18.5 percent emulsion concentrate at the rate of one pint in three gallons of water per acre applied by aircraft gave excellent control of cranberry weevil, green cranberry spanworm, and false armyworm, but was ineffective against black-headed fireworm.

Malathion 50 percent emulsion concentrate at the rate of one quart in five gallons of water per acre applied by aircraft gave nearly perfect control of first brood black-headed fireworm. After a period of almost spectacular control of black-headed fireworms and blunt-nosed leafhoppers. DDT in many instances is now ineffective. Malathion, because of its safety and effectiveness against these resistant strains, appears to be one of the better substitutes for DDT on cranberries.

EPN 300 (Ethyl p-nitrophenyl thionobenzenephosphonate) and malathion gave slightly better control of cranberry fruitworm than the standard recommendation of 7 pounds of 4 percent rotenone plus 2 pounds of fish oil soap, where as Ryania, cryolite, 50 percent wettable DDT, methoxychlor, and TDE were all less effective than the rotenone fish oil soap sprays.

—W. E. Tomlinson, Jr.

Blueberry Insects. Grubs of the undetermined weevil mentioned in the previous report were determined by the U.S. National Museum to be the currant fruit weevil, *Pseudoanthonomus vallidus* Dietz. This insect is not uncommon in lowbush berries in Maine and the Maritime Provinces, but is hitherto unreported on cultivated berries in Massachusetts or elsewhere.

Both cranberry fruitworm, *Mineola vaccinii* Riley and Cherry

fruitworm, *Grapholitha packardi* Zeller were common in cultivated berries in 1953. Plum curculio, *Conotracheles nenuphar* Herbst was also found infesting green fruit in limited numbers.

A survey of several of the older cultivated blueberry plantings during the Fall of 1953 indicated that the virus disease, blueberry stunt, is present in most of them in very small amounts. In only one field was the incidence greater than 1 percent. However, leafhopper traps maintained in several of the fields caught a number of the leafhopper vectors of the disease, *Scaphytopius magdalensis* (Prov.) For that reason growers should become familiar with stunt disease and promptly rogue diseased plants to avoid more rapid spread of the disease.

—*W. E. Tomlinson, Jr.*

Beach Plum Insects. Methoxychlor 50 percent wettable powder at the rate of 3 pounds per 100 gallons of water applied during the cover sprays effectively controlled plum curculio and plum gouger, but 2½ pounds of 25 percent malathion wettable powder in the cover sprays did not give adequate control.

—*W. E. Tomlinson, Jr.*

Strawberry Insects. Because of cool, wet weather during the Spring of 1954, strawberry weevil and two-spotted mites were not particularly troublesome.

A 3 percent Aramite dust applied at 50 pounds per acre burned strawberry foliage and small green fruit. When applied at 30 to 35 pounds per acre, there was no injury, and satisfactory mite control resulted from the lighter application.

Though 5 percent chlordane dust has given good control of strawberry cutworms in most fields where it has been used, strawberry aphids have increased markedly necessitating an application of an aphicide.

—*W. E. Tomlinson, Jr.*

DEPARTMENT OF DAIRY INDUSTRY

D. J. HANKINSON IN CHARGE

Sanitizing Agents for Dairy Use.

1. *Iodine as a Sanitizing Agent for Dairy Use.* The germicidal properties of iodine in combination with surface active agents are being investigated. The following test organisms have been used: *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhosa*, *Pseudomonas aeruginosa*, and *Bacillus cereus*. Germicidal tests were conducted in distilled water and the effect of hard water and contaminating material such as milk and dishwash soil were determined. Iodine (12.5 ppm.) in distilled water killed all of the non-spore-forming organisms after 15 seconds contact, while the spore former *B. cereus* was not completely killed after 5 minutes contact. The performance of 25 ppm. of iodine in the presence of hard water (500 ppm. $CaCO_3$), whole milk (1 percent), and standard dishwash soil (1 percent) was satisfactory. Indications are that the new iodine germicides have some advantages over germicides now commonly used by the dairy industry.

The commonly used thiosulfate method is not accurate for measuring iodine concentrations below 100 ppm. A new colorimetric method is being investigated and found to be accurate for iodine concentrations as low as 5 ppm.

—*W. S. Mueller.*

2. *Detergent-Sanitizers for Washing Eggs.* In cooperation with the Poultry Husbandry Department a preliminary investigation on egg washing has been started. A detergent-sanitizer solution was compared with plain water in washing dirty eggs with a mechanical egg washing machine. Washed eggs are in storage at various temperatures and are being checked from time to time for quality. Eggs have not been in storage long enough to draw conclusions.

—*W. S. Mueller in cooperation with J. H. Vondell, Poultry Husbandry Department.*

Antioxidants of Cacao Origin for Dairy Products.

1. *Antioxidants Isolated from Cacao Shell.* A polyphenolic fraction, isolated from cacao shell, appears to be a mixture of cacao tannin, cacao brown and phloroglucinol. It appears that these materials are responsible for the increase in the induction period of butter oil when cacao shell or its extracts are added. In combination with synergists the cacao antioxidant is somewhat more effective than commercial antioxidants now being used.

—*W. S. Mueller and E. J. Finnegan.*

2. *Thiobarbituric Acid (T.B.A.) Test for Measuring Spoilage in Milk Fat.* Further studies on the development of oxidized flavor in milk show that the T.B.A. values are more closely correlated with flavor analysis than peroxide test values.

—*W. S. Mueller and K. Blazys.*

3. *Sunshine Flavor in Milk.* Milk, especially homogenized milk, when exposed to sunshine for a short time, often develops an objec-

tionable flavor called "sunshine" or "activated" flavor. This off-flavor in milk is attracting much attention today because of the great increase in the use of homogenized milk. A study of the value of various antioxidants in preventing the solar activated off-flavor has been started this year.

—W. S. Mueller, D. J. Hankinson, and A. B. Karas.

Detection of Incorporated Air in Homogenized Milk. The presence of air as microscopic foam in homogenized milk has been a very annoying problem to milk dealers because of the short measure in evidence several hours after bottles are filled. An attempt was made to devise an instrument which would indicate the presence of air in the milk prior to bottling. This instrument was composed of a specially calibrated metal float located in a by-pass milk line at the discharge of the homogenizer. Preliminary tests indicate that the instrument is practical.

—H. N. Charlap and D. J. Hankinson.

Keeping Quality of Cottage Cheese in a Vacuum Package. The relative short keeping quality of cottage cheese undoubtedly has a bearing on the amount consumed. Recently vacuum plastic packages have been used for certain food products for freezing, and a similar use has been proposed for fresh cottage cheese. Tests with a saran plastic bag showed that when half-pound lots of cottage cheese of good quality were placed in the plastic bags, the product would keep approximately one week longer than when packaged in conventional paper cottage cheese containers. However, the use of the vacuumized bags gave little advantage over the nonvacuumized bags. Cheese stored in five-pound bags showed little improvement in keeping quality, whether or not vacuumized. When cheese of poor quality was placed in the bags, it spoiled as rapidly as when packaged in paper containers.

Control tests included yeast and mold counts, total bacteria counts, pH, and organoleptic examination over a period of four weeks.

—P. S. Smith and D. J. Hankinson.

DEPARTMENT OF ECONOMICS

PHILIP L. GAMBLE IN CHARGE

Public Land Ownership in Rural Areas of Massachusetts. To evaluate the significance of public land ownership in rural areas and to determine its effect on agriculture and rural communities, additional information has been obtained on land holdings by various political subdivisions. Likewise, pertinent data were secured in regard to valuation of public property, total assessment in rural towns, and the spread in agricultural land values. In a preliminary analysis, publicly owned lands were classified both by the prevailing major uses and by geographical distribution in various sections of the State. State land ownership has been found in 226 of the 312 towns, Federal land ownership in 74 towns, and county land ownership in only 26 towns. There is considerable variation in the amount of land owned by towns within their own boundaries. Fifty-five towns own less than 25 acres each, while 39 towns have an individual ownership of over 500 acres. In addition, some towns own considerable land areas in other towns, largely for water supply purposes.

The percentage of town areas in public land varies from less than 1 percent to as high as 65 percent. Inasmuch as the extensive public ownership in some areas affects both the agriculture and the economic structure of the community, some of the towns in this category present a problem of adjustment, and in fact raise the question of the feasibility of maintaining them as independent political units.

Likewise, with new land uses spreading into rural areas, the evidence provided points to some lines of action to safeguard the position of agriculture in the emerging pattern of land use.

— *David Rozman and Ruth E. Sherburne.*

Major Trends in Cow Population in Massachusetts. Bulletin 474, published March 1954. This study brings out some major factors in the evaluation of the dairy industry in the State. The data on cow population and young stock are analyzed for selected years from 1925, indicating the distribution of dairy livestock with shifts among individual counties and various sections of the State. Of major importance are the data indicating the number of cow herds and distribution of these herds by different sizes. According to the evidence obtained the number of farms and other units with only a few cows and smaller herds has been on a definite decline in the State. In 1925 there were 28,342 units keeping dairy animals, some of them with only one or two cows. This number decreased to 10,606 in 1952. On the other hand, there were more farms in 1952 with twenty or more cows and the proportion of cows in the herd size of twenty or more increased from 35.9 percent in 1935 to 64.4 percent in 1952. Another significant development registered by the study is the increase in the proportion of young stock in relation to total cow population. In 1952 the percentage of young stock to the total number of cows stood at 42.2 compared with 27.2 in 1925.

— *David Rozman and Ruth E. Sherburne.*

DEPARTMENT OF ENTOMOLOGY

CHARLES P. ALEXANDER IN CHARGE

Investigations on European Corn Borer Control. The warm late fall and comparatively mild winter provided very favorable conditions for corn borer survival, and little or no winter mortality of the larvae was noted.

The prevailing cold, wet weather in early spring and throughout May considerably retarded spring pupation. Fifty-percent pupation was not observed until May 21 to 23 during one of the infrequent and brief periods of fair, mild weather. There were only three periods of fair, mild, rainless weather of three or more days' duration in the month of May. Rainfall was about double the normal amount for the month. Growth in the plantings of early sweet corn was retarded, and only during the closing week of the month was a more normal rate of development noted. The first moth emergence was recorded on May 21. During early June more favorable weather prevailed. The insignificant amounts of the infrequent rains did not interfere with insect activity, and both the corn and the corn borer advanced normally. Egg deposition was found very generally during early June, and hatching occurred about June 10 to 12. In the test plots the first sprays and dusts were applied June 15. Three applications were made at 7-day intervals (June 15, 22, and 29). Continued lack of rain and some periods of very high temperature during late June caused the grower to irrigate his corn. This was especially necessary during late June and in July to allow the corn to maintain growth and mature the crop. Sprays of DDT and three Ryania formulations were made, and five Ryania combinations in dust form were applied.

Counts of tassel breakage and tip infestation made on July 7 showed 99 percent of the plants in sprayed plots free from injury and 97 percent in the dust plots as compared with 68 percent borer-free plants in the unsprayed check plots.

The test plots were harvested and checked July 20 to 24. In the sprayed plots 2 of 1044 ears were infested, or a ratio of 1.9 to 1000 ears. In the dusted plots, 6 of a total of 477 ears contained borers, or 12.5 to 1000 ears. In the unsprayed check plots, 44 of 242 ears were infested, a ratio of 182 to 1000 ears.

A reduction in both grade and total yield was caused by borer attack, as indicated in the record of the DDT-sprayed plots. The DDT plots yielded 334 ears: none injured by borer, and 253 of grade 1 quality. In the unsprayed check plots of the same size, total yield was 306 ears: 63 infested, and only 204 of marketable grade. Reduced to the comparable basis of 1000 plants, DDT plots showed 989 ears and 748 of Grade 1 quality, whereas check plots yielded 942 ears, of which only 648 were of first quality.

The great potential of the corn borer as a pest is indicated by the above figures. In a comparatively mild attack (79 percent of total yield, clean corn in check plots as compared with 99 percent in treated plots) the total yield was appreciably reduced, and only 66 percent of this yield was corn of marketable quality.

—*A. I. Bourne.*

Tests of Malathion for Control of Orchard Pests. The Summer of 1953 was a season of severe attack by European red mite and other species. In the Owen orchard (a block of mixed varieties), red mite successfully resisted several efforts for control, and by mid-July had developed a heavy infestation; some foliage bronzing on Baldwins and Delicious had occurred. Counts showed 50 to 60 mites to a leaf on those varieties. Malathion at 2 pounds per 100 gallons applied July 14 removed all active stages of the mites, and no subsequent reinfestation developed. Only an occasional mite was found thereafter. This block also included McIntosh, Cortland, Early McIntosh, and several other McIntosh relatives. No injury followed the use of Malathion. Apparently this chemical can be safely applied to McIntosh and related varieties without the injury caused by other organic phosphates (Parathion etc.)

In late summer the prolonged drought and high temperatures killed ground-cover under the trees in many blocks of apples and peaches in the Station orchards, and two-spotted mites moved up into the trees in large numbers. Most of the apple blocks and the peaches were given an application of Malathion with satisfactory control. None of the blocks required more than one spray.

In the variety pear block the purpose of the test was to determine the effectiveness of Malathion in mid-season upon a heavy attack when all stages of Psylla were present. The Psylla was allowed to go unchecked until July.

On July 1, counts of terminals and water sprouts averaging 10 inches in length showed a maximum of 30 adults, 2000 nymphs, and 3000 eggs per 10-inch twig, and a minimum of 9 adults, 734 nymphs, and 830 eggs per 10-inch twig.

On July 6, Malathion 2 pounds to 100 gallons was applied to the entire block with an Iron Age Sprayer with a Hurst attachment.

On July 9, examination showed no living adults nor living nymphs. Clusters of dead nymphs were still attached to twigs; very few living eggs were found.

The application of July 6 was made on a day of very high wind and, consequently, heavy drifting. Since some doubt was felt of the thoroughness of the coverage and effectiveness, a follow-up spray was applied a few days later.

Experience showed that the second application was unnecessary. The infestation was obliterated for the balance of the season.

—*A. I. Bourne*

Comparative Value of Standard Miticides against Red Mite in Mid-Summer Applications. The outline of the tests planned involved applications in pink, calyx, and second cover sprays. Red Mite, however, appeared late in the test block and was slow in building up.

Infestation in force appeared in early June well after the date of the second cover spray. On June 1 a composite sample from the entire block showed 15 active mites and 1890 eggs per 10-leaf sample. Spraying was delayed until considerable hatching had occurred. The miticides were applied on June 9. Six days later, samples of the unsprayed

checks showed 1320 mites per 10 leaves; Aramite 31, Dimite 43, Ovotran 12 and Chlorobenzilate 2.

The third cover spray was applied June 18; 4 days later, counts showed 1000 mites and 2500 eggs on check trees. On sprayed trees the mites had been reduced to 2 to 4 mites per treatment, but eggs were numerous on all trees, and 8 days after the spray application of Aramite, the mites were building up in numbers to 211 mites per 10-leaf samples. DiMite and Ovotran were still holding the mites. The fourth cover spray was applied June 3. After a 7-day period, checks showed a steadily increasing mite and egg population, which reached its peak July 17 with counts of 3630 mites per 10-leaf samples and with severe bronzing. All the sprays reduced the mites from 0 to 2 mites per 10 leaves. Seven days after the sprays and 17 days after the fourth cover no serious build-up had occurred. Counts taken 21 days after the fourth cover showed that Aramite- and Ovotran-sprayed trees had a marked increase in mite population, but after applications of Dimite and Chlorobenzilate very few mites were present. A special spray was applied successfully on July 21 to attempt a clean-up. At that date very few mites or eggs remained on sprayed trees, and the mite population on unsprayed checks had declined to an average of 300 to 400. Through August, Red Mites declined rapidly throughout the entire orchard, although a few were still present as late as August 26. The record in this block demonstrated the difficulties in making a clean-up of a red mite infestation by any mid-season schedule. Apparently, sufficient eggs are present to furnish a dangerous build-up even though the active mites are well cleared by the sprays. Even after three applications at 9- and 12-day intervals, there was sufficient increase after 21 days to make a fourth spray necessary.

All the miticides gave good initial kill of the active stages on mites. Ovotran at the dosage used seemed to allow some of the adults to escape, which probably explains the heavy reinfestation in August.

Aramite was effective for a short period; but twice during the season, eggs were sufficient to cause such a heavy reinfestation that further spray applications were required.

After applications of Dimite and Chlorobenzilate on July 9, 18, and 30 no significant or serious reinfestation took place.

—*A. I. Bourne.*

Potato Spraying Experiments. The season of 1953 was marked by sharp contrasts in weather conditions, which had a profound effect upon the growth of all crops. The mean daily temperature for May was slightly above normal, but the total rainfall for the month was 6.76 inches compared with a normal of 3.6 inches. Some rain occurred on 16 days of the month. Thereafter, severe drought conditions prevailed during the entire period of the growing season with less than half of the normal precipitation, the driest growing season in 50 years.

Attack by Early Flea Beetles was about normal and was satisfactorily checked by insecticides. The second brood of beetles was heavy in numbers by the third week of July and reached its peak by the end of that month with a few stragglers into mid-August. Insecti-

cides on July 22 and 29 readily checked the attack, and very little evidence of feeding was noted thereafter.

Leafhoppers were not present in significant numbers at any time during the season in the Station plots.

The pink and green aphids appeared in late July and early August. TEPP in one application (August 5) almost removed them for the season.

The protracted drought and the excessively high temperature in late August probably had a more depressing effect upon growth and yield than any of the insect pests. From May 29 to September 17, rainfall was considerably less than half the normal and occurred for the most part in a few widely scattered storms. The summer was the driest in 50 years.

Yield records reflected the unfavorable growing conditions, and were lighter than normal in all plots. In the absence of serious insect attack, differences in yield between plots were not great. Blight was not of significant importance. None of the insecticides showed any depressing effect on yield.

Flea Beetle Control Tests. Tests of DDT, Chlordane, and Metacide were made in the experimental plots and all showed very pronounced effect on Flea Beetle activity. Counts were made at the height of the second brood attack, and the materials checked on the basis of the amount of beetle feeding perforations. Relative damage per 25 growing tips showed 5210 on unsprayed checks, 115 on DDT sprayed foliage, 195 in Metacide plots, and 165 on Chlordane-sprayed plants. DDT gave 97.8 percent reduction in feeding damage, Metacide 96.2 percent reduction, and 96.8 percent reduction where Chlordane was applied.

All three materials were very effective and of particular significance. Flea Beetle resistance to DDT was not evident in the Station plots.

—*A. I. Bourne.*

Control of Onion Thrips. Although the mean daily temperature for May was slightly above normal, apparently the maximum daily temperatures were sufficiently low to insure about normal growth. Rain for the month was nearly twice the normal amount. Such a combination of weather conditions promoted steady and normal growth of the crop and seriously impeded thrips activity.

The first adults were found on set onions May 12 to 15, but in general the infestation developed slowly. On set onions infestation was not generally of serious proportions before the crop matured. Plantings of sweet Spanish sets, which matured late in the summer, and fields of seed onions met a heavier attack favored by the hot, dry conditions which prevailed from June through September.

The test plots on the Station farm were planted to set onions in early May, some delay being necessary because of the interruption by frequent rains. Growth was slow at the outset, but the plants made rapid growth during June. Thrips attack was slow in developing and did not reach real proportions until late June–early July when the

plants were advancing rapidly toward maturity.

Insecticide applications were made July 7 at which time thrips infestation included 40 adults and 975 young thrips per 25 plants. Sprays were all applied with sufficient pressure to penetrate the deep "chits" or base of inner leaves. This was impossible to accomplish with dusts, but plants were covered as thoroughly as possible. All sprays were fortified with Triton 1956, as a wetting agent, except Black Leaf 40, which was given a Potash Fish Oil soap as a spreader and activator for nicotine.

None of the materials caused injury to onion plants. Examination of the plots the day after application failed to show any living thrips on the plants in the sprayed plots. Almost all thrips reached by the dusts were dead, but failure of the dusts to penetrate the "chits" allowed some thrips to escape.

Similar counts made after a 7-day interval showed almost no restocking of the plants after applications of Chlordane, Dieldrin (wettable powder or emulsion) and very light reinfestation of thrips after applications of Toxaphene, Heptachlor, or DDT. Plants sprayed with Malathion at either the 2- or 4-pound dosage showed substantial reinfestation. The plots sprayed with Black Leaf 40 showed approximately the same infestation as the checks, which averaged 35 adults and 1875 young per 25 plants.

The counts indicated that with a thorough application to cover the leaf surface and at sufficient pressure to penetrate the tight "chits," all the material tested would give an almost perfect initial kill. Chlordane, Dieldrin, Toxaphene, and DDT showed excellent residual effect. Malathion gave almost perfect initial kill, but comparatively slight protection after 3 or 4 days, even when the dosage was doubled.

—*A. I. Bourne.*

Insects in Relation to Forage Crops in Massachusetts. During the early season, spittlebugs and aphids were generally present in clover and alfalfa plantings and were the two most abundant pests of those crops through that period.

Spittlebugs appeared on alfalfa about May 10, when the plants in most fields were 15- to 20-inches high. The very heavy rainfall in May caused such rapid growth of clover and alfalfa that no damage from insect attack was apparent. Spittlebugs reached the adult stage as the alfalfa was coming into bloom.

Field observations at the time of the first cutting of alfalfa showed that spittlebug nymphs can reattack stubble and young plants and will carry on to maturity if the crop is left on the field for more than a few hours.

If alfalfa is cut for green silage and run through the chopper the same day, apparently few bugs manage to transfer; in this way most of the bugs are removed from the field.

Field and laboratory tests indicated that these nearly mature nymphs are very difficult to kill.

The serious drought that persisted from May 29 through the remainder of the season overshadowed any damage caused by incidental feeding by insects present.

The second cutting, about mid-July, was not so heavy as normal, and the anticipated third cutting was omitted.

Leafhoppers were observed during August; but new growth was so badly stunted by drought, it offered very little attraction for any insect attack.

—*F. R. Shaw and A. I. Bourne.*

Effect of Pesticides upon Beneficial Insects. In tests with aphid-eating Coccinellids, methoxychlor produced more than 95 percent mortality at one-fourth to one-fifth the normal concentrations, whereas 4 to 5 times the usual concentrations of dieldrin gave less than 20 percent mortality. Direct applications of sprays were much less toxic to Coccinellids tested than exposures to residues for as little as 5 minutes.

Several materials were tested for the first time on ladybeetles. Malathion was highly toxic, but residues of ferbam, phenyl mercury (Coromerc), captan, sulfur, phygon, and thiram caused slight to no mortality.

Parathion sprays were highly toxic to pupae of *Stethorus punctum* as well as to larvae and adults.

A population of *Stethorus* eliminated an extensive, heavy mite infestation of dock and dandelion in one orchard in spite of three applications of methoxychlor to the trees. Many of the beetles were killed, but some survived and started a late season build-up on European red mite.

The movement of adult *Stethorus* and development of populations was directly related to development of mite populations rather than to a time factor or to calendar dates.

—*John A. Weidhaas, Jr.*

Control of Insect Pests of Shade Trees and Ornamental Shrubs. To meet the needs of arborists, landscape gardeners, nurserymen, tree wardens, moth superintendents, property owners, etc., work on this project is directed toward evaluating the newer insecticides and miticides to determine the extent of pesticide injury on different plants.

Insect Control Tests (With Hydraulic Sprayers): The quantities of pesticide given in parentheses are the amounts applied per 100 gallons of water. None of the materials listed here injured any of the plants sprayed.

Applications during Foliage Season.

Woolly beech leaf aphid: Excellent control was had with a 53- and a 57-percent malathion emulsifiable liquid (1 ½ pints).

Snowball bush aphid: Promising control was had with a 25-percent malathion wettable powder (2 pounds) applied in the spring when the leaves were still very small. A late dormant application may be better.

Pine bark aphid: Promising control was had with a 53-percent malathion emulsifiable liquid (1 ½ pints) applied in late May.

Aphids on elm leaves: Promising control was had with a 25-percent malathion wettable powder (2 pounds).

Larch aphid: Promising control was had with a 53-percent malathion emulsifiable liquid (1 ½ pints).

Satin moth caterpillar: Very promising control of mature larvae was had with a 50-percent methoxychlor wettable powder (2 pounds).

Birch leaf miner: Promising control was had with a 53-percent malathion emulsion (1 ½ pints).

Willow mites (*Schizotetranychus schizopus*): Excellent control was had with a 50-percent malathion emulsifiable liquid (1 ½ pints). Considerable reduction of mites was had with a 50-percent Ovotran wettable powder (1 pound).

Spruce mite: Good to excellent control was had on spruce and/or *arbor vitae* with the following miticides: a 15 percent aramite wettable powder (1 ½ pounds) and a 30 percent emulsifiable liquid (¾ and 1 ½ pints); a 25 percent chlorobenzilate wettable powder (1 ½ pounds) and a 25 percent emulsifiable liquid (1 ½ pints); a 25 percent malathion wettable powder (1 ½ and 2 pounds) and a 50 percent emulsifiable liquid (1 ½ pints); a 50 percent Ovotran wettable powder (1 ½ pounds) and a 20 percent emulsifiable liquid (1 ½ and 3 pints). Material reduction of mites resulted from using a 25 percent dimite emulsifiable liquid (1 and 1 ½ pints); a 50 percent genite emulsifiable liquid (1 ½ pints) and a 25 percent wettable powder (3 pounds); and a 60 percent toxaphene emulsion (3 pints).

Mites on elm leaves (several species): Mites have become much more prevalent on elms in July and August because towns have been applying so much DDT to combat elm leaf and bark beetles. Unfortunately, unfavorable weather spoiled a series of tests to determine the effectiveness of the miticides listed in the preceding paragraph against the mites that infest elm leaves. It was learned, however, that those miticides used alone or in combination with a 35 percent DDT emulsifiable liquid, (7/10 quart) containing xylene and Triton X-100, caused no spray injury on elms. No spray injury resulted from combining du Pont's 24 percent methoxychlor emulsifiable liquid (1 quart) with a 50 percent Ovotran wettable powder (1 pound), or a 20 percent emulsifiable liqud (1 ½ pints).

Spray Injury Tests (With Hydraulic Sprayers): The following pesticides were applied to many broad-leaved plants and a few needle-leaved plants with no noticeable spray injury to foliage, except where noted. (The amount of pesticide per 100 gallons of water and the air temperature and relative humidity at the time of application are given in parentheses.)

Dormant applications: Superior oil (2 gallons, 56°F., 44 percent. DN289 (2 quarts, 64°F., 26 percent).

May foliage applications: 60 percent toxaphene emulsifiable liquid (2 quarts, 71°F., 37 percent). A possible exception here is red maple which may have been injured by this application; sugar maple was unharmed.

August foliage applications: Chlorobenzilate emulsifiable liquid (1 ½ pints, 75°F., 47 percent). Chlorobenzilate wettable powder (1 ½ pounds, 77°F., 52 percent). Malathion emulsifiable liquid (1.6 pints, 76°F., 34 percent).

—*W. B. Becker.*

Reducing Borer Damage to White Pine Sawlogs with Benzene Hexachloride (BHC) Sprays. Almost complete protection of white pine sawlogs against round- and flat-headed borers, ambrosia and bark beetles, and bark weevils was had with a 0.4 percent gamma content BHC emulsion spray. Good protection was had with a 0.2 percent gamma BHC spray. Somewhat less than desirable protection was had against some borers with a 0.1 percent gamma BHC spray, based on the number of insect tunnels found in the logs. The unsprayed checks were well riddled by the borers.

The spray emulsions, all diluted with water from a commercially prepared 20 percent gamma emulsifiable liquid concentrate, were applied only once in the early spring to the freshly cut logs before the borers could attack them. There were 10 logs in each spray treatment.

In the autumn the logs were sawed into lumber (a total of 1590 board feet) and the lumber graded. Grade of lumber is based on the presence or absence of several types of defects, insect damage being only one factor. The lower grades of lumber are less valuable. As far as insect damage is concerned, downgrading (to number 5 common) due to worm holes amounted to 6.1 percent of the lumber from logs sprayed with 0.4 percent gamma BHC; 5.3 percent of the lumber from logs sprayed with 0.2 percent gamma BHC, and 8.9 percent of the lumber from logs sprayed with 0.1 percent gamma BHC. In the unsprayed checks, downgrading due to worm holes amounted to 81.4 percent of the lumber.

—W. B. Becker, H. G. Abbott, and J. H. Rich, Departments of Entomology and Forestry.

Studies of the Insect Vectors of Dutch Elm Disease.

Effect of Insecticides on Elm Bark Beetle Breeding Material. Elm bark beetles breeding in elm logs were prevented from emerging or were killed immediately after emerging when such logs were sprayed with either a 1-percent DDT emulsion or a 0.4 percent-benzene hexachloride emulsion (each diluted with water). Such results were obtained in three separate experiments. If no living vegetation is in the vicinity of the logs, these sprays may be diluted with fuel oil for more effective results.

Since these same insecticides also keep the beetles out of beetle breeding material (the bark on any recently killed elm log or tree), such spraying may be done when prompt burning of logs is not possible. When standing elms that are dying or dead cannot be cut and burned, the DDT emulsion spray (diluted with water), which is not toxic to most living plants, might be applied to them to halt beetle activity *temporarily. All bark surfaces must be thoroughly wet by the spray for effective results.* Prompt destruction by cutting plus burning is still recommended where it can be done.

Spraying to Prevent Beetles from Inoculating Healthy Living Elms with Dutch Elm Disease Fungus. One such test (with mist blower) was started in 1949 in the vicinity of a neglected elm dumping site where beetle breeding occurred in enormous numbers and where many nearby elms had died of Dutch elm disease within a few years. Unexpectedly, and at the same time, the city authorities burned all

the beetle breeding material there and have kept it clean ever since. Even though we spray a number of near-by elms heavily with DDT, as is required for long lasting prevention of feeding by these beetles, and the city sprays other nearby elms more lightly, while another group of elms in an inaccessible area is left unsprayed, only one test elm has contracted Dutch elm disease to date in the unsprayed plot. This seems inconclusive in regard to the effect of spraying.

It is evident that the great reduction in the incidence of Dutch elm disease at the site was coincident with the intensive elm sanitation measures.

A similar test started elsewhere in 1951 (where elm sanitation has been generally satisfactory) has also been inconclusive to date in regard to spraying. Hydraulic sprayers were used in this test. The large amounts of DDT required have killed some birds, mostly robins, and a gray squirrel. Bees were poisoned when the brief windy prefoliar spraying season necessitated spraying while elms were in blossom. Mites have also become troublesome on the elms sprayed with DDT and methoxychlor. Methoxychlor was proved earlier to be about as effective as DDT in preventing feeding by elm bark beetles. It is reportedly about one twenty-fourth as toxic as DDT to warm-blooded animals but costs two to three times as much.

—W. B. Becker.

Preventing Borer Injury to Unseasoned Hardwood Logs with Benzene Hexachloride (BHC) Sprays. Spraying oak logs of cordwood size with a 0.4-percent gamma benzene hexachloride emulsion (diluted with water) gave almost complete protection against all borers. Ambrosia beetles and round-headed borers were the principal pests involved. Unlike last year, good protection resulted from an application of a 0.2 -percent gamma BHC emulsion. A 0.1-percent gamma BHC spray was less effective.

Somewhat comparable results were obtained with maple and birch logs where ambrosia beetles were the principal pests.

—W. B. Becker, in cooperation with the Department of Forestry.

Biological Control of Japanese Beetles. Milky disease spore dust (type A) was applied to several lawn areas infested with Japanese beetles in Berkshire and Bristol Counties. Previously, plots had been treated in Hampden, Hampshire, and Franklin Counties. The Federal Japanese Beetle Control Office is interested in this work and supplied the spore dust for the test, which is a cooperative experiment. More information is desired on this subject in this region.

It will probably be several years before the results of the treatments can be assessed.

—W. B. Becker, in cooperation with the U. S. Department of Agriculture.

Biology and Control of Grape Cane Girdler. A moderate to heavy infestation of the grape cane girdler was controlled by spraying with all-purpose mixtures. The most effective mixture contained 50

percent methoxychlor 30 percent, 50 percent captan 30 percent, 25 percent malathion 20 percent, and an inert carrier 20 percent, used at the rate of 10 pounds in 100 gallons. Applications made 4 to 6 days after previous spray reduced the number of girdled canes 100 percent; at an interval of 7 to 9 days, 97.08 percent; and after 10 days or more, 96.35 percent. This treatment also controlled the grape tomato gall.

The project is now completed.

—W. D. Whitcomb, Waltham.

Control of Insects on Cucurbits in Relation to Yield. Satisfactory control of the squash borer was obtained with lindane, aldrin, and dieldrin dusts. On squash, all treated vines produced about twice the yield as the untreated vines. On cucumbers and melons, the vines treated with copper-rotenone dust produced the greatest yield. Malathion dust reduced the yield slightly.

Squash on vines treated with aldrin, dieldrin, or heptachlor dust were found to have significant degree of off-flavor. Lindane dust appeared to cause less flavor contamination than in previous years.

—W. D. Whitcomb and W. J. Garland, Waltham, in cooperation with W. B. Esselen, Department of Food Technology.

Control of Injurious Insects and Mites in Greenhouse with Aerosols. Experimental applications of aerosols containing 15-percent malathion, 10 percent malathion plus 5 percent Aramite, and 10 percent malathion plus 2 percent lindane were safe on carnations but the malathion-lindane formulation was significantly less effective against the red spider mite. Temperatures about 80° F. with a normal greenhouse humidity produced more effective results than treatments at lower temperatures. Applications of the malathion-Aramite formulation caused moderate to severe leaf injury to cucumbers in ground beds.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Plum Curculio in Apples. Methoxychlor and dieldrin gave excellent control of the plum curculio on apples in the regular applications. However, dieldrin was very unsatisfactory for the control of codling moth, red-banded leaf roller, and oriental fruit moth and, therefore, cannot be substituted for methoxychlor without the addition of other insecticides to control these pests. Methoxychlor emulsion was effective and safe when combined with ferbam, but it was unsatisfactory in 1952 when combined with ferbam plus sulfur.

—W. D. Whitcomb and W. J. Garland, Waltham.

Investigations of Materials Which Promise Value in Insect Control.

Control of Cabbage Maggot. On early cabbage, emulsifiable concentrates and wettable powders prepared at the rate of ½ pound actual toxicant in 50 gallons of water and applied at the rate of 4 ounces per plant as a drench were equally effective. As a dust these materials required two applications to equal one application as a drench. In

general, aldrin was the most satisfactory insecticide.

On late turnips, seed treatment, soil treatment, and dusting of the plants with heptachlor and dieldrin all failed to give satisfactory control of the cabbage maggot. No effective control treatment was found.

All purpose sprays for home orchard pest control were tested on many fruits under home orchard conditions, and on peaches under commercial conditions. A formula containing 50 percent methoxychlor 30 percent, 50 percent captan 30 percent, 25 percent malathion 20 percent, and an inert carrier 20 percent used at 1 pint in 10 gallons of water gave 90+ percent control of all pests and was the best formulation used. This work was used as the basis for home orchard fruit spraying recommendations by the Extension Service.

Apple Maggot Control. When the soil in cages was drenched in June at the rate of 1 pint per square foot with dieldrin emulsifiable concentrate diluted to 1 pound actual dieldrin in 100 gallons, about 50 percent of the expected flies emerged, but none lived 24 hours. However, when this treatment and other similar treatments were applied just before the maggots entered the soil in September, the maggots pupated normally. Dieldrin and methoxychlor sprays applied to the grass and weeds under the trees killed 90 percent or more of the flies within 24 hours of their emergence.

—W. D. Whitcomb and W. J. Garland, Waltham.

The Use of Systemic Insecticides for the Control of Insects Attacking Ornamental Trees and Shrubs. Experimental treatments with the proprietary systemic insecticides Systox, Pestox, and Isolan gave control of the spruce gall aphid on Norway Spruce, the birch leaf miner on gray birch, Comstock's mealy bug on Taxus, soft brown scale on holly, and two-spotted mite on roses. Systox was the most effective of these materials. Elm leaf beetle, Japanese beetle, and the spring canker worm were not killed by these treatments. Concentrations of 0.1 percent on gray birch and of 0.15 ond 0.2 percent on American elm caused severe foliage injury to small potted trees.

—Fred O. Ames, Waltham.

FEED, FERTILIZER AND SEED CONTROL SERVICES

JOHN W. KUZMESKI IN CHARGE

Feed, fertilizer, seed, and milk testing laws are administered as one service, and the operations of each, with the exception of the milk testing law, are reported in annual control series bulletins.

Under the milk testing law 3,915 pieces of Babcock glassware were calibrated, and 174 certificates of proficiency in testing were issued. All milk depots and milk inspection laboratories in the Commonwealth were visited at least once to check apparatus and general conduct of the work.

In addition to the regulatory work, feeds, fertilizers, and other agricultural materials have been examined for citizens of the Commonwealth without charge whenever the results were considered of interest to the general public or to the Control Services. Samples of feed, stomach contents, and viscera of animals have been tested for the presence of toxic ingredients.

Considerable work has been done on research projects in cooperation with other departments of the University and Experiment Station. The results of such work are reported by the departments originating the projects.

In the Seed Laboratory, 5,519 service and inspection samples were received and tested. The laboratory also received and cleaned 74 lots of tobacco seed.

Since March 1, 1954, when the Soil Testing Laboratory became a part of the Control Services, 1,344 samples have been tested.

DEPARTMENT OF FLORICULTURE

CLARK L. THAYER IN CHARGE

Effect of Nutrient Elements and Light on Carnations. After a day of 50-percent or more of possible sunlight, carnation plants were grown at a minimum night temperature of 60° F.; after a day of less than 50-percent sunlight, the plants were maintained at a night temperature of 50° F. During the day, all plants were grown at a temperature of 50° F.

Production of three carnation varieties was increased by transferring the plants to 60° F. after a day of high light intensity.

In the varieties White Sim and Sidney Littlefield, splitting was reduced; quality as determined by weight and stem length was higher by transferring plants to 60° F. after days of high sunlight.

—J. W. Mastalerz, Waltham.

Effect of Light on Prolonged Chrysanthemum Bloom and Change of Flowering Habit. The quality of pot chrysanthemums and the length of pedicels were not affected by interrupted short-day treatments, but production time was increased, and the possibility of producing three crops a year was eliminated.

The method of pinching chrysanthemums with day-length manipulation to replace manual pinching was impractical because 30 or more short days were necessary to retard terminal growth before auxiliary buds developed. No effective method was found.

Pot chrysanthemums grown in equal parts of peat and sand and fertilized bi-weekly with a nitrogen-potassium solution were comparable to plants grown in a composted soil mixture. Advantages from the use of a peat and sand mixture include an automatic fertilizing schedule, the elimination of soil preparation, and a decrease in shipping weight.

—J. W. Mastalerz and F. J. Campbell, Waltham.

Effect of Nutrient Elements on Growth of Roses. Better Times rose plants grown in soil that received one application of potassium chloride at rates of 2, 3, and 4 pounds per 100 square feet of soil area in a three-year period showed no significant differences in yield of blooms when compared with soil receiving no additional potassium. The original soil by analysis contained 135 ppm of potassium and 722 ppm. of calcium. Flower production over the three-year period appeared to be influenced more by age of the plants and methods of pruning than by increases in soil-potassium levels. Flower production increased each year with a maximum attained the third year of culture with a decrease in production the fourth year. There were no significant differences in grades of flowers produced, based on stem length and weight.

An incomplete summary of data on analysis of soils and plant tissue for potassium and calcium over the three-year period shows that with increases in potassium levels in the soil there is a corresponding increase in uptake of potassium by rose plants and a decrease in

uptake of calcium. No differences were noted in uptake of potassium or calcium in relation to seasonal growing conditions. Mildew was just as prevalent on plants grown at high levels of potassium as it was at lower levels.

Soils and rose plants were analyzed for the three-year period in a commercial range concurrent with the plot experiments. The original soil in this range contained 170 ppm. of potassium, 1945 ppm. of calcium, and 290 ppm. of magnesium. Here the uptake of potassium and calcium tended to follow trends observed in the smaller experimental plots.

Periodic analysis of plant tissue for total nitrogen indicated that nitrogen nutrition was adequate during the experiment.

—Harold E. White.

Effect of Different Storage and Curing Treatments on Eucharis-Lily Bulbs. Bulbs graded to size, ranging from 2 ½ to 3 inches in diameter, were subjected to storage temperatures of 36 to 38° F. and 65 to 100° F. for intervals of 7 to 28 days to determine whether the flowering of Eucharis could be regulated by such treatments. Storage at temperatures of 65 to 100° F. did not influence flowering as compared with untreated bulbs. Temperature treatments of 36 to 38° F. for as little as seven days stimulated bulb reproduction and retarded vegetative growth. The degree of vegetative retardation and stimulation of bulb reproduction increased with the interval of exposure to low temperature.

In another phase of the experiment, foliage was removed from a number of bulbs before being given the storage temperature treatments with bulbs that had not been defoliated. The purpose of defoliation before treating and replanting was to determine whether such treatment was harmful compared to the customary practice of replanting with all the foliage. Defoliation of bulbs before treatment or replanting did not affect subsequent growth or flowering.

Bulbs replanted at the end of the first year in early July gave a substantially larger crop of flowers in January than bulbs not replanted. An early August replanting was not so effective in producing a winter crop of flowers as the July replanting.

Data on bulb size in relation to rate of reproduction indicate that bulbs 2 ½ to 3 inches in diameter produce, on the average, 3 to 4 off-sets per bulb the first year after replanting. Bulbs less than 2 to 2 ½ inches in diameter do not reproduce off-sets so readily as larger bulbs and do not flower so readily.

—Harold E. White.

Treatment of Greenhouse Rose Soil with Synthetic Soil Conditioners. In 1952, two synthetic soil conditioners, Aerotil (40 percent active material) and Krilium 631 (25 percent active material), were applied to rose soil in a commercial greenhouse range. The conditioners were applied at a low rate based on 0.40 pounds of active material per 100 square feet and at a high rate based on 2.0 pounds of active material per 100 square feet. The conditioners were applied to soil before and after steam-sterilization as well as to unsterilized soil.

Manured and unmanured soil plots were treated with conditioners. The soil treated with conditioners had been cropped to roses for seven years.

Two years have elapsed since the conditioners were applied, but as yet soil compaction and structure of treated soil plots have not differed discernibly from soil compaction and structure of untreated soil plots.

Unsteamed soil showed more compaction than steamed soil. Rose plants in manured soil appeared to have heavier growth and a darker green-colored foliage than those in unmanured soil irrespective of soil conditioner treatment. The soil in all steamed areas with or without conditioners was of such structure that cylinder plugs could not be taken because the soil crumbled on removal.

—*Harold E. White.*

Timing of Carnation Production. Carnation plants (variety Red Sim) ranked highest in number of flowers produced per square foot for each month of production. The plants were benched as rooted cuttings on April 15 receiving a solid pinch or benched on May 15 with a single pinch. High production also was obtained from plants benched on May 1 or March 15 with a solid pinch.

Sharp production peaks occurred with several planting dates and with the three methods of pinching because of abnormally high fall temperatures. Production peaks in December were recorded with the June 15 benching, single pinch; April 15 benching, solid pinch; May 1 benching, solid pinch; May 15 benching, solid pinch; and, April 15 benching, 2 and 2 pinch.

—*J. W. Mastalerz, Waltham.*

Factors Affecting the Rates of Respiration, Water Absorption, and Transpiration of Cut Flowers. The rates of transpiration and water absorption of cut carnation flowers when placed at room temperature (73°F.) were higher than the rates of the flowers placed at 32°F. for a period of 24 hours. Flower life was a day longer after the 24-hour period at low temperature.

At a relative humidity of 90 to 95 percent, transpiration and absorption at 73°F. were reduced approximately one-half. Flowers lived 2 to 3 days longer than those at a relative humidity of 20 to 30 percent.

Carnation flowers in commercial flower preservatives transpired and absorbed 500 percent more water and lived 75 to 100 percent longer than those placed in water without preservative. Similar rates of transpiration and absorption were recorded for cut carnations after dry storage at 31°F. for 4 weeks.

Experiments on the effect of water temperatures on transpiration and absorption of carnations were not concluded. Stem tissues were injured within 24 hours, and bacterial growth increased at water temperatures higher than 90 to 100°F.

Measurement of transpiration and absorption indicated that flower life was limited to approximately one additional day whenever transpiration exceeded absorption. No conclusions were formulated

regarding the role of transpiration or water absorption in the life of cut carnations.

—*J. W. Mastalerz, Waltham.*

Response of Snapdragons to Day-length and Temperature. Seventeen fewer days were required for snapdragons to flower with a 16-hour day-length (25 foot-candles) compared to a normal day-length; 7 additional days were required with a 12-hour day; and 21 additional days, with an 8-hour day. Increasing the intensity of the artificial light to extend the day-length reduced the time to flower. Delaying the application of lights after planting reduced the time saved to flower a crop with a 16-hour day.

Snapdragons were most sensitive to increased day-length at a stage of maturity measured by 8 developed leaves. Plants with 8 developed leaves grown at 50, 55, and 60°F. and placed under a 16-hour day-length flowered in the shortest time. The higher the temperature, the shorter the time required to flower.

Increased day-length reduced quality as measured by stem length and weight and hastened flowering. Removing lights after 6 to 8 weeks improved quality considerably.

—*J. W. Mastalerz and F. J. Campbell, Waltham.*

Low Temperature Storage of Cut Flowers and Cuttings. Growing three varieties of carnations plants in "mother blocks" at temperatures of 50, 55, and 60°F. did not affect the number of cuttings produced, the percentage of rooting before and after storage, nor the quality of stored cuttings after 4 months at 31°F.

Rooted carnation cuttings packaged in polyethylene film were stored for periods up to 6 months, and unrooted cuttings were stored up to 4 months. Lack of gas exchange and moisture loss accounted for poor quality in the cellophane and acetate films. The use of aluminum foil for storing carnation and chrysanthemum cuttings was also demonstrated.

Rooted chrysanthemum cuttings were stored at 31°F. for 3 to 5 weeks when packaged in polyethylene or cellophane. Variation in rooting response and foliage quality suggested that storage of unrooted chrysanthemum cuttings could not be recommended. Growth response and flowering of rooted chrysanthemum cuttings were comparable to those for nonstored cuttings.

—*J. W. Mastalerz, Waltham.*

Relationship of Nitrate Fertilization to the Age of Snapdragons. A selection of Rockwood White had the following treatments: (*a*) liquid feed at planting time, (*b*) delay in liquid feed for one week, (*c*) delay for three weeks, (*d*) delay for five weeks, and (*e*) no feeding (check). Treatments *a*, *b*, *c*, and *d* were all followed by weekly feedings that contained nitrates but had phosphorus and potassium adjusted according to the level recorded by soil analyses.

There were no significant differences between liquid feeding treatments for average spike length, stem length, weight, and number of days to first flower. There was, of course, a significant difference be-

tween the liquid feeding treatments and check for weight, average spike length, and number of buds and florets, but none for stem length and number of days to first bloom. Soil analyses indicated that treatments *a*, *b*, and *c* were all approximately in the same nitrate range 6 weeks after planting and remained in this range until maturity. Treatment *d* never reached the same nitrate level as treatments *a*, *b*, and *c*. According to the data recorded under these conditions, these preliminary tests indicated that an immediate liquid feeding of nitrate after benching and a delay up to five weeks before liquid feeding of nitrates have no significant effect on either quality or number of days to first bloom.

—*F. J. Campbell, Waltham.*

Effect of Steam Sterilization on Massachusetts Greenhouse Soils. Six soil preparations, (*1*) field soil, (*2*) field soil plus manure, (*3*) field soil plus peat and sand, and (*4*), (*5*) and (*6*) treatments *1*, *2*, and *3* plus superphosphate were steam-sterilized and sampled in duplicate at regular intervals for 2 ½ months. Soluble salts and pH were determined on the date of sampling. Data compiled on nitrates indicate that all treatments followed the same trend of high nitrates immediately after steaming and dropped off abruptly by the third day, followed by a slight increase, and then leveled off for the remainder of the sampling period. Treatments *4* and *5* indicated higher levels of nitrate followed by treatments *2*, *1*, *6*, and *3* in decreasing order. The addition of superphosphate before steam-sterilization appears to increase the amount of extractable nitrates to a small extent.

Ammonia had a negligible decrease for the first four days and then began to build up in all treatments. This increase was markedly higher in treatments *2* and *5*, and built up for the sampling period for treatment *2*, but had a slight leveling off in treatment *5*. Treatment 1 had a high point approximately 1 month after sterilization followed by a sharp decrease and then leveled off. Treatment *3* reached its highest point 1 ½ months after sterilization and then leveled off. Treatments *4* and *6* had a sharp increase 2 weeks after sterilization, a sharp decrease, and then a gradual build-up with leveling off at the end of 2 ½ months. The addition of superphosphate effects a negligible increase in the amount of extractable ammonia.

The pattern for manganese in all treatments was very irregular. A slight decrease was generally indicated for the first day followed by a sizable increase by the third day and a decrease by the fourth day, and so on until a general decrease was realized at the end of 2 ½ months. The addition of superphosphate increased slightly the amount of extractable manganese for the first month and a half but indicated a lesser amount of extractable manganese at the end of 2 ½ months.

Soluble salts followed the same general pattern in all treatments; however, those treatments without superphosphate were in a low range, and those with superphosphate were in a medium-high range. None of the treatments reached a soluble salt reading high enough to be considered toxic.

All treatments followed the same pattern of an increasing pH for the first three weeks after steam-sterilization and then leveled off. The addition of superphosphate lowered the pH slightly. The order of

treatments for decreasing pH was *2*, *5*, *1*, *4*, *3*, and *6*.

The effects of steam sterilization on phosphorus, potassium, calcium, and iron and the relationship of these elements within a treatment and between treatments are to be determined.

F. J. Campbell, Waltham.

The Effect of Iron Chelators on Nutrition of Roses. In these preliminary investigations iron complexed as mono-sodium ferriethylene diamine tetraacetate dihydrate (NaFeEDTA) was observed to be effective in correcting symptoms of iron chlorosis in roses and gardenias. The iron chelate was applied in a dry form at the rate of 4 to 24 ounces per 100 square feet of soil area. Chlorotic rose foliage regained its normal green color in 3 to 7 weeks from date of treatment. One-year-old gardenia plants made a similar response to treatment with iron chelate, but two-year-old plants responded less readily.

A chelating agent, tri-sodium ethylenediamine tetraacetate (Na_3EDTA) applied to roses and gardenias at the rate of 4 to 12 ounces to 100 square feet of soil area was just as effective as the chelated iron form in correcting symptoms of iron chlorosis.

Foliar applications of iron chelate at the rate of 2 pounds to 100 gallons of water caused severe injury to the young growth of rose plants but was not harmful to gardenia foliage. The young foliage of roses was burned, and distortion of the leaves and shoots was evident. No improvement or greening of the chlorotic rose foliage resulted from the foliar treatments.

—H. E. White.

DEPARTMENT OF FOOD TECHNOLOGY

CARL R. FELLERS IN CHARGE

Frozen Stuffed Chickens. A twelve-month storage test with frozen stuffed chickens has been completed. Putrefactive anaerobe spores inoculated into the stuffing were not affected by freezing and frozen storage. The aerobic, anaerobic, and putrefactive anaerobe populations in the dressing of frozen stuffed chickens did not change significantly during storage of the chickens for 12 months at −10°F. The type of packaging material apparently had no significant effect on the bacteria content of the dressing.

—W. B. Esselen and A. S. Levine.

Brine Immersion Cooling and Freezing of Packaged Ready-to-Cook Poultry. Chilling and freezing rate data have been obtained for packaged and unpackaged poultry ranging in size from chicken broilers to stags and from young hen turkeys to mature tom turkeys, cooled by immersion in various liquid media at temperatures ranging from 33°F. to −20°F. Data on the time required for a pound of hot, eviscerated, packaged birds to chill to 40°F. were also obtained. Chilling packaged, ready-to-cook poultry in −20°F. brine, followed by holding in a cold room at 36°F., offers a rapid and effective method of removing the body heat prior to freezing or distribution as a fresh product.

—W. B. Esselen and A. S. Levine in cooperation with I. J. Pflug, Department of Agricultural Engineering.

Freezing Eggs. An investigation on the effect of freezing on the chemical and physical characteristics of egg yolk has been continued. Egg yolks become gummy upon freezing and do not reconstitute easily. Proteolytic enzymes to prevent gumminess were studied. At a concentration of 0.05 percent, papain mixed with the yolks for 15 minutes at 74°F. effectively prevented gumminess or gelation without any off-flavor or odor. However, no method for inactivating the enzyme without producing undesirable changes in the eggs has been successful. Proteolytic enzymes appear to reduce the chain length of the yolk proteins. Papain loses its activity after about ten months in frozen storage. Very rapid freezing and thawing affords considerable protection against gelation.

—C. R. Fellers and W. Powrie.

Grades and Standards for Processed Foods. The grades of the Agricultural Marketing Service of the U.S. Department of Agriculture have been studied from the consumer's viewpoint to see whether the present grades are useful in evaluating processed foods correctly. It would appear that although all the grades yield useful and pertinent information, none pays sufficient importance to flavor and possible color and general attractiveness. On the other hand, such grading factors as shape, number of pieces, and freedom from defects are not

of great importance in consumer acceptance. Extensive samples of AMS graded canned pears, frozen strawberries, canned salmon, canned tomato juice, and frozen concentrated orange juice have been carefully graded and examined in the laboratory with a view towards evaluating the grade structure.

—C. R. Fellers and E. M. Elbert.

Composition and Keeping Quality of Cranberries. Studies on the effect of bog location on keeping quality and jellying properties of cranberries have been continued. A section of the bog at the Massachusetts Cranberry Experiment Station was divided into subsections based on elevation, vine thickness, and moisture conditions of the soil. On the basis of cranberry samples from this bog area during the past season, bog elevation had no apparent relationship to the jellying and keeping qualities of the fruit. Although berries on thick vines appeared to spoil faster in storage than berries on thin vines, vine thickness did not appear to affect the viscosity or gel strength of the juice and sauce from the fruit. Viscosity of the cranberry juice was related to the gel strength of cranberry sauce made from it.

—W. B. Esselen, A. Kotula, and C. R. Fellers in cooperation with The Cranberry Experiment Station, East Wareham.

Stabilization of Natural Fruit Pigments in Fruit Products. Jellies and preserves of anthocyanin-pigmented fruits undergo a relatively rapid discoloration in storage, particularly at the high storage temperatures. This discoloration is due to chemical changes involving, on the one hand, the degradation of the anthocyanin pigments, with a resulting bleaching of the red color, and, on the other hand, the non-pigment constituents, such as sugars, acids, and pectin, which react to form brown-colored end products. Ascorbic acid and some of the sugar degradation products present in preserves are capable of accelerating the destruction of the anthocyanins. During the past year the work carried on has been concerned primarily with strawberry products and pelargonidin-3-glucoside, the predominant strawberry anthocyanin. Although the extent of pigment destruction as a result of exposure to heat can be minimized by increased care in preparation and storage of preserves, color retention in strawberry products would be materially increased if the action of active carbonyl compounds on the anthocyanin could be prevented.

—G. E. Livingston, R. V. Decareau, P. Markakis, N. Pandit, Z. Sabry, M. A. Steinberg, and C. R. Fellers.

Thermal Death-Time Methods. (See Department of Agricultural Engineering.)

Nonenzymatic Browning in Strained Foods. Pigment content of strained green beans undergoes relatively little change during storage, even though a darkening of the product may be taking place. An early total conversion of chlorophyll to pheophytin occurs during preparation and processing of the product, and further pigment degradation is not

evident. The color change during processing is due, in part, to the conversion of chlorophyll to pheophytin and, in part, to the darkening of the plant tissue. Storage darkening, however, seems to be associated with tissue darkening only. Studies on pigment-free green bean tissue have demonstrated the adverse effect of heat, oxygen, and certain chemical constituents, but the actual mechanisms whereby these reactions proceed have not as yet been explained. Though the possibility that a conventional Maillard-type reaction may be responsible has been considered, there is evidence that other darkening mechanisms may also be involved, since tissue discoloration has been demonstrated in the absence of reducing sugars. Somewhat similar studies on strained carrots are in progress.

—G. E. Livingston, D. E. Westcott, M. P. Baldauf, I. S. Fagerson, and W. B. Esselen.

Effect of High Temperature–Short-Time Canning Processes on Strained Foods. Storage and quality evaluation tests are being continued on strained baby foods canned by aseptic methods. Results to date indicate that the greatest value of these newer processing methods lies in improved color and thiamine retention. Other differences affecting pH, color of tissue, and the colloidal phase of vegetable products have been noted and are being studied further. Flavor differences were in most cases statistically imperceptible.

—G. E. Livingston, W. B. Esselen, E. Feliciotti and D. E. Westcott.

Preparation of Low Baumé Pickles. Inasmuch as this type of pickle differs from conventional sweet pickles by possessing both lower acid and sugar contents, it requires heat processing to insure an adequate storage life. Pasteurization for 25 minutes in water at 180°F. was adequate to destroy contaminating bacteria as well as added inocula of known pickle-spoilage microorganisms. The enzyme peroxidase was also destroyed by this heat treatment.

Packing cut-up pickles in the volume ration of two parts of pickle to one part of sirup (60 percent sucrose and 4.0 percent acetic acid) and processing as recommended above resulted in a satisfactory low Baumé pickle with cut-out values of about 26 percent sugar and 1.2 percent acetic acid. Packs of these pickles stored up to 11 months at room temperature retained a good flavor and texture.

—E. E. Anderson, W. B. Esselen and M. Cryan.

Sweet Pickle Relish Improved by Addition of Hydrocolloids. Effects of the incorporation of seven trial thickening agents on the flavor and liquid separation of pickle relish indicated that after one year's storage at both 72°F. and 113°F., the best results were obtained with an Irish Moss extractive and with sodium carboxymethylcellulose in concentrations of 0.15 to 0.30 and 0.25 to 0.50 percent, respectively.

—E. E. Anderson, W. B. Esselen and A. P. Blank.

Role of Sugars and Organic Acids in the Inhibition and Destruction of Acid Food Spoilage Microorganisms. Studies have been

carried out in a bacteriological medium on the effect of varying concentrations of sucrose (up to 60 percent and acetic and citric acids up to 5 percent) on the inhibition of growth of four recognized acid food spoilage microorganisms. Results have indicated growth of all test organisms in both acetic and citric acid concentrations up to 5 percent when used in a complete nutrient medium containing 30 percent sucrose, but a lack of growth in similar acid concentrations at sucrose levels of 45 or 60 percent.

—E. E. Anderson, W. B. Esselen, P. Markakis.

Comparison of Canned Fruits Prepared as Water, Sucrose-, Sucaryl-, and Saccharin-Sweetened Packs. Additional canned packs of sweet and sour cherries, blueberries, raspberries, peaches, pears, and plums were put up using standard sugar sirups and sirups containing equivalent amounts of sweetness from Sucaryl, and saccharin, and water. These packs were then stored at room temperature and evaluated by taste panels at 3-month intervals for relative acceptability. Statistical evaluations of the ratings indicated that invariably the sucrose sweetened packs were the most, and the water packs the least, acceptable. In the packs sweetened with the noncaloric sweeteners, although some approached the sucrose packs in acceptability, none exceeded them. For the most part, the fruits sweetened with Sucaryl were considered slightly superior to the saccharin-sweetened packs.

—E. E. Anderson, R. Lampi and W. B. Esselen.

Pre-Peeled Potatoes. After immersing peeled white potatoes for 15 seconds in an aqueous solution of sodium bisulfite containing 10,000 ppm. of SO_2 and packaging in polyethylene bags, storage lives of from two to three weeks were realized at temperatures of 40°F. or below. There was no appreciable difference in the storage life of different varieties of potatoes or of the same variety grown in different locales when treated as outlined above. After eight days' storage at 35°F., the SO_2 picked up by the potatoes in the standard dipping treatment caused losses of thiamine ranging from 11 to 13 percent in whole potatoes and from 30 to 47 percent in French fries.

—E. E. Anderson, W. B. Esselen and E. Feliciotti.

Factors Affecting the Quality of Frozen Blueberries. The results of subjective (taste panels) and objective (penetrometer) evaluations of the texture of commercially cultivated blueberries frozen in 14 different packing media classified the thawed blueberries in three groups on the basis of increasing berry firmness: (A) those frozen in water, sodium saccharin, sodium Sucaryl, and 20°-Brix sucrose sirup; (B) the all berry pack and those frozen in 30- and 40°-Brix sirups; and (C) those frozen as a 4:1 dry sucrose pack or in 50- or 60°-Brix sirups.

After 12 months' storage at 0°F., incorporation of thawed, drained blueberries from all packs into pies minimized differences in texture so that all were considered acceptable except those packed in the 60°-Brix sirup, which were both too firm and too sweet.

—E. E. Anderson and W. B. Esselen.

Stability of Peroxidase in Salt Stock Pickles During Curing, Freshening, and Packaging. Inasmuch as residual activities of peroxidase and other enzymes are known to cause off-flavors in pickles and other foods, the activity of peroxidase was followed in two 14,000 gallon tanks located at a near-by pickle plant. After a progressive decline in peroxidase activity in the first 2 months of curing and storage, the level of activity remained quite constant at a fairly high level over the next 7 ½ months. At this time, these pickles were prepared for the consumer trade by freshening and packaging into retail packages. Examination of pickles withdrawn from the freshening tanks showed the presence of peroxidase but at a much lower level than was present in the original salt stock. After these pickles were made up as dill, sour, sweet mixed or Kosher dill pickles, there was no evidence of residual peroxidase activity. Packs are undergoing storage at room temperature for possible peroxidase regeneration.

—E. E. Anderson, W. B. Esselen and R. Lampi.

Rodenticide Investigations. The deterioration of the killing power of Fortified Red Squill has long plagued the pest control industry.

A new, so-called Stabilized Fortified Red Squill is now available and is reported to retain its original toxicity for an extended period. This new red squill is now undergoing storage tests to study its keeping qualities. Results obtained to date, after 185 days, indicate that this stabilized material has maintained its original toxicity rating. Fortified Red Squill is still preferred where a quick kill is needed in areas that are heavily populated. The emetic principle (safety factor) is an important consideration in the selection and use of Red Squill. Good quality anticoagulant rodenticides are readily available and are selected over most other rodenticides, even though they are relatively slow in action.

L. R. Parkinson and F. A. Vlach.

Chinchilla Research. The raising of chinchilla for their fur has now progressed beyond the hobby stage. To date the industry has survived almost entirely through the sale of breeding stock. No established market for pelts has yet been created, and the only pelts which have been available were from sick or casualty animals. The chief factor which has delayed the fur market is the lack of uniformly good pelts. Most animals born have been kept and used for breeding, resulting in a most heterozygous strain of animals. There is an extreme need of a selective breeding program. The tendency toward monogamy of the females makes this type of breeding program difficult as one cannot always obtain desired matings. The establishment of a practicable program of artificial insemination, similar to that used in the cattle industry, would be a very desirable accomplishment. Research in artificial insemination technique has been in progress for the past year. An improved method has been devised for drawing sperm samples. Vaginal smears have been taken daily in order to study the phases of the estrous cycle in order that the proper time of inseminations might be determined. Two successful inseminations have been obtained. However, many females have been inseminated using essentially the

same technique. This limited success is not fully understood at this time. Because of the difficulty in obtaining pregnancies during the regular cycle of the female and in view of some reported success in post-partum inseminations, it has been decided to obtain as many natural matings as possible and concentrate on inseminations in the post-partum period this coming year.

—L. R. Parkinson and F. A. Vlach.

Toxicological Studies on Sodium Lauroyl Sarcosinate. During the past year toothpaste manufacturers have stressed the fact that their product contains an anti-enzyme which will prevent normally present mouth bacteria from exerting unfavorable effects, such as dental caries and unpleasant breath. This study was initiated to investigate any toxicological or other adverse physiological effects that might possibly occur from extended use of this compound.

As a result of prolonged ingestion at levels of 2 percent and 4 percent, respectively, it was found that the 4-percent feeding level was too high for the rats to tolerate, and at the 2-percent feeding level no harmful effects were noted. Six of the original 20 rats on the 4-percent feeding level survived the entire test period (90 days). However, the survivors were undersized and in very poor condition. The 2-percent feeding level was continued for 180 days and at the end of this period, there appeared to be little if any difference between this and the control group. It was concluded that sodium lauroyl sarcosinate is nontoxic to rats at a feeding level of 2-percent of the total ration. This feeding level is several hundred times greater than is used in toothpaste and, therefore, the amounts of this anti-enzyme compound that might be consumed would not be considered as toxic. A series of feeding tests were also set up to determine the LD_{50} of sodium lauroyl sarcosinate. It was found that the LD_{50} for rats was between 2.7 and 3.1 gm/kg.

—L. R. Parkinson, C. R. Fellers and F. A. Vlach.

Final Toxicological and Physiological Studies of Ethylene-Diamine Tetra-Acetic (EDTA) Acid in the Albino Rat. The subacute and chronic toxicity studies on 50 Wistar albino rats fed a marginal low-mineral purified diet at two feeding levels, 0.5 percent and 1.0 percent using two EDTA salts, Na_2EDTA and $Na_2CaEDTA$, indicated that there was a growth depression at the 1.0 percent Na_2EDTA level over a 200-day period. Growth in all other groups was normal. The metabolism studies revealed that more than 85 percent of the orally ingested EDTA could be reclaimed in the feces. The average recovery of EDTA was 90 percent in both urine and feces indicating that EDTA is only slightly metabolized. The study of the decalcifying effects of EDTA showed that at the 1.0 percent level of Na_2EDTA, there was some decrease in the ash content and the amount of calcium in the femurs and tibiae, and a slight increase in the calcium level of the blood serum.

A careful inspection of the teeth of the rats showed no marked dental caries, but there was some evidence of erosion and occlusal attrition of the molars in the 1.0 percent Na_2EDTA group. The incisors were unaffected.

There was no significant difference in the B.M.R. and blood counts of the several groups, but the 1.0 percent Na_2EDTA appeared to have a slightly delayed coagulation time. The histopathological studies showed no differences, and no abnormalties were found.

It is concluded that Na_2EDTA at the 1.0 percent feeding level exerts a somewhat greater decalcifying action than $Na_2CaEDTA$. There are no harmful effects from ingesting levels of these salts as great as 1.0 percent, other than an occasional slight case of diarrhea. $Na_2CaEDTA$ is to be slightly preferred because of its lesser decalcifying effects on the body. EDTA is only slightly metabolized. Since the feeding levels in these tests are far in excess of the levels used in the food industry, the use of these salts can be considered safe. In the food industry these compounds help to prevent the browning in foods. This is accomplished by a chelation of the EDTA and trace amounts of heavy metals, such as iron and copper. These metals also act as catalysts in the breakdown of ascorbic acid, and their inactivation would greatly improve certain food products.

—L. R. Parkinson, M. S. Chan, and C. R. Fellers.

Equilibrium Relative Humidity Studies. This project has been continued. (See Annual Report 1952-1953). While the semimicro method has, in general, shown good correlation with macro methods in current use, certain improvements are desirable in connection with its use with extremely hygroscopic products because of moisture pick-up during weighing. Methods of overcoming this problem are being studied.

—I. S. Fagerson and A. S. Levine.

Effect of Monosodium Glutamate on Processed Foods. Eight frozen products, clam chowder, haddock fillets, spaghetti sauce, beef stew, chicken-à-la-king, codfish cakes, rosefish fillets and French fried potatoes were prepared with three different levels of added monosodium glutamate (MSG) in addition to control packs without MSG. Samples were withdrawn at approximately three-month intervals for taste panel evaluation of palatability. The products were stored at −10°F. and 0°F. MSG improved palatability of clam chowder, haddock fillets, beef stew, and rosefish fillets. The palatability of codfish cakes and chicken-à-la-king was improved in those samples held at −10° F., but not at 0° F. Palatability of spaghetti sauce and French fried potatoes with added MSG was not significantly different from control samples at either storage temperature.

A theory on the possible relationship of the flavor of MSG to the distribution of its various ionic forms as a function of pH has been proposed. The theory explains the effectiveness of MSG when added to certain foods whose pH lies between 4.5 and 7.0 and is coincident with the predominance of one ionic form of glutamate in this pH range.

—I. S. Fagerson, H. Brody, and C. R. Fellers.

Quality of Processed Foods. This project has been continued, and during the past year evaluations of quality of the following products were made.

Canned Sauerkraut: Thirty-five different brands were examined and graded according to available U.S. Dept. of Agriculture grades. Twenty brands were graded as A, 13 as Grade C (there is no Grade B classification for canned sauerkraut), and 2 as Grade D.

Frozen Spinach: Two types of frozen spinach were examined in accordance with U.S. Department of Agriculture grades. These were whole and cut spinach. Twenty-two brands of whole spinach and 23 brands of cut spinach were graded. Of the former, 12 brands were graded as A, 8 brands as grade B, and 2 brands as grade D (there is no grade C classification for frozen spinach). Seven brands of cut spinach were graded as A, 16 as grade B, and 1 as grade D.

Frozen Strawberries: Forty-four brands of this product were examined according to U.S. Department of Agriculture standards. Twenty-five brands were graded as A, 15 as grade B, and 4 as grade D (there is no grade C classification for frozen strawberries). Reduced ascorbic acid content ranged from 6.9 to 55.0 mgm. per 100 grams with an average of 33.4 mgm. per 100 grams.

Canned Salmon: Five varieties of the product were examined. These were Chinook, Red, Silver, Pink, and Chum. Six brands of Chinook salmon were examined, of which 4 were graded as A and 2 as B. Seventeen of the 22 brands of Red salmon examined were grade A, and 5 were graded as B. Eight brands of Silver salmon were examined; only 1 brand graded as A, 7 brands were grade B. Seventeen brands of Pink salmon were examined, of these, 10 were graded as A, and 7 as B. Only 4 brands of Chum salmon were examined. Two brands being graded as A, and 2 as B.

Canned Tomato Juice: Forty brands of canned tomato juice were examined in accordance with U.S. Department of Agriculture grades for this product. Twenty-eight of the brands were found to be Grade A, 10 brands grade C (there is no grade B classification for this product), and 2 brands grade D or substandard. Sodium chloride content ranged from 0.52 to 1.36 percent with an average of 0.89 percent. Reduced ascorbic acid ranged from 1.8 to 29.3 mgm. per 100 grams with an average of 15.6 mgm. per 100 grams.

Canned Pears: Thirty-seven brands of this product were examined in accordance with U.S. Department of Agriculture grades. Nineteen brands were grade A, 13 brands grade B, and 5 brands grade C.

Frozen Brussel Sprouts: Sixteen brands of frozen brussel sprouts were examined in accordance with U.S. Department of Agriculture grades. Ten brands were grade A, 4 brands grade B, and 2 brands grade C. Reduced ascorbic acid values ranged from 23.0 to 114.4 mgm. per 100 grams with an over-all average of 68.1 mgm. per 100 grams.

Frozen Broccoli: Two types were examined: whole and chopped. Grading was carried out according to U.S. Department of Agriculture grades. Of the 17 brands of whole broccoli examined, 10 were grade A, and 7 grade B. Reduced ascorbic acid ranged from 35.7 to 98.6 mgm. per 100 gms. with an average of 62.4 mgm. per 100 grams. Thirteen brands

of chopped broccoli were examined, 6 being grade A and 7 grade B. Reduced ascorbic acid ranged from 7.2 to 95.2 mgm. per 100 grams with an average of 58.1 mgm. per 100 grams.

—I. S. Fagerson, E. E. Anderson, K. M. Hayes, and C. R. Fellers.

DEPARTMENT OF HOME ECONOMICS NUTRITION

ANNE W. WERTZ IN CHARGE

Protein and Amino Acid Metabolism in Pregnancy. *Human Subjects.* As a means of obtaining more information on protein metabolism during pregnancy, the dietary intake and urinary excretion of the 8 essential amino acids are being determined in pregnant women on different levels of protein intake. Each subject's amino acid intake and excretion are first established on her usual diet, and then the diet is supplemented with certain amino acids, and the response to supplementation studied. The data obtained thus far on a study of tryptophan supplementation in five subjects suggest that there is wide individual variation in the amount of the dose that is excreted. The individual with the lowest dietary tryptophan intake excreted the smallest percentage of the dose. Results also indicate that the amount of tryptophan excreted by an individual is much higher in the pregnant than in the nonpregnant state.

Albino Rats. The ability of littermate rats to produce young on 15-percent and 8-percent protein rations was studied. All the females on the 15-percent protein ration succeeded in producing good litters. Resorption of young occurred in approximately one-half of the females on the 8-percent protein ration.

—A. W. Wertz, M. E. Lojkin, L. P. Guild, G. C. Murphy, and P. Kane.

Amino Acid Content of Foods. Analyses for tryptophan, lysine, leucine, isoleucine, methionine, valine, phenylalanine, and threonine have been made on many foods that are commonly eaten. Certain vegetables, cereal products, egg dishes, and mixed meat dishes are included in the food analyzed.

—A. W. Wertz, P. Kane, and L. P. Guild.

Metabolism of Nicotinic Acid and Tryptophan in Pregnancy. Further studies were conducted on the factors in pregnancy that stimulate the high excretion of the metabolites of nicotinic acid as reported previously (Mass. Agr. Exp. Sta. Bul. 459, p. 64, 1950; Bul. 467, p. 69, 1953).

Effect of Ration of Tryptophan to Other Amino Acids. Changes in the ratio of tryptophan to other amino acids in the experimental rations were produced by supplementing the control diet with 10-percent and 15-percent acid-hydrolyzed (tryptophan-free) casein. Each rat was

used as her own control by successive breedings on the different rations. The data obtained thus far with the rations supplemented with acid-hydrolyzed casein suggest that the addition of other amino acids to the ration affect the metabolism of tryptophan and nicotinic acid.

Effect of Hormones. Results of previous experiments suggested that hormones had some effect on the excretion of metabolites of nicotinic acid. The inconsistency of the results obtained both in these and in previous experiments with estrogen and progesterone might possibly be attributed to the varying amounts of these hormones normally present in the animal. To eliminate this variable factor, rats were ovariectomized before hormone injection. From the limited results obtained thus far, it appears that in the ovariectomized rats injections of a combination of estrogen and progesterone result in increased excretion of N′methylnicotinamide. This increased excretion persists for some time after the injections are discontinued. Injections of A.C.T.H., on the other hand, seem to depress the excretion of N′methylnicotinamide in intact, but not in the ovariectomized, rats.

—*M. E. Lojkin and A. W. Wertz.*

DEPARTMENT OF LANDSCAPE ARCHITECTURE

R. H. OTTO IN CHARGE

Factors Increasing the Rapidity of Growth of Nursery Stock. Experiments on the propagation of Gable and Glen Dale hybrid azaleas indicated that they would root well without hormone treatment providing bottom heat is used.

Soaking cuttings of American Holly (*Ilex opaca*) overnight in solutions of mineral nutrients before treating with hormone powder stimulated earlier and heavier rooting.

A plastic cover resting directly on the holly cuttings helped to increase the humidity. This method of providing high humidity was satisfactory during December, January, and February, but the cuttings became too hot with the advent of more sunlight in March. Raising and shading the cover may be helpful in preventing the burning of cuttings.

Terramycin and Thiolutin, antibiotic materials, were used in propagation trials with Upright Yew (*Taxus cuspidata capitata*) and Hick's Yew (*T. media hicksi*). They depressed rooting rather than suppressed rooting of the cuttings.

—*R. L. Tichnor and P. F. Bobula, Waltham.*

Study of Herbaceous Perennial Material. During 1953, a total of 71 new herbaceous perennial plants was added to the Perennial Gardens to determine whether or not they may be of value as ornamentals under the climatic conditions prevailing in Massachusetts.

In addition to these herbaceous perennials, a total of 130 different varieties of spring flowering bulbs was added to the Perennial Gardens. This select collection of spring-flowering bulbs will be of value as demonstration material to acquaint the gardening public with the kinds and varieties of bulbous plants that usually give satisfactory results when nominal cultural care is provided.

The initial plantings of cooperative trials of new varieties of garden chrysanthemums were made during 1953. Of the 10 varieties submitted for testing by the University of Minnesota, five varieties were equal in performance to the better varieties in the trade that have similar characteristics. Two of the five varieties submitted for trial by the University of Nebraska were equal in performance to the better varities in the trade that have similar characteristics.

—*P. F. Bobula, Waltham.*

Control of Weeds in the Nursery by Chemical Sprays. Three herbicidal materials, CMU, Crag Herbicide #1, and Sovasol #5, were applied to miscellaneous nursery stock during the Summer of 1953. Because rainfall was light, weeds were not heavy. However, Sovasol and Crag Herbicide at 4 or 6 pounds per acre gave satisfactory control. CMU at 1 pound per acre gave control without injury to the nursery stock, but at rates of 2 pounds and more per acre injury occurred.

Eleven herbicidal materials were applied to established witchgrass in a planting of day-lilies (Hemerocallis), which had been set out in 1948. Three materials were effective in killing the tops of the witchgrass: pentochlorophenol, sodium pentachlorophenate, and sodium trichloroacetate. These materials burn the day-lily foliage, but by careful application burning is minimized, and the growth of the grass is suppressed.

—*R. J. Stadtherr, R. L. Tichnor, and P. F. Bobula, Waltham.*

Hardiness of Commercially Available Azaleas in New England. The Winter of 1953-54 has indicated that definite varietal differences in hardiness exist in the 69 varieties of commercially available azaleas planted at the Waltham Field Station. After a dry summer, and a long, warm, wet fall, the temperature dropped to 10° F. on December 16, 1953. A few days later, the splitting and cracking of bark was very evident on some of these 3-year old plants. In the following Spring the varieties with heaviest cracking; Coralie, Damozel, Hatsushimo, Isabel, Joya, Magic, Mrs. Wrey, Seigetsu, and Thalia, were killed. Other varieties that gave little evidence of bark splitting in December bloomed satisfactorily in the spring. These were Boudoir, Herbert, LaLumiere, LaRoche, Mello Glo, Mildred Mae, Purple Splendor, Royalty, and Viola. Most of the other varieties were injured to a degree or failed to bloom.

—*R. L. Tichnor, Waltham.*

DEPARTMENT OF OLERICULTURE

GRANT B. SNYDER IN CHARGE

Breeding Sweet Corn, Peppers, and Field Tomatoes for Massachusetts.

Sweet Corn. The hybrid C13 et gl x 21547-1-1 has been named Golden Beauty and wide scale tests during 1953 indicated it to be a superior early variety. It matures about two days before Marcross and provides an excellent home and market garden variety in its maturity range. Adequate seed supplies of Golden Beauty will be available from seedsmen in the Spring of 1955. Another experimental hybrid, 53.17, performed particularly well in the 1953 trials and matured in the same season as Marcross. Its yield, appearance, and quality were especially noteworthy.

Peppers. Ten single plant selections were made of early maturing sweet peppers that appear to resist tobacco mosaic. These strains produce rather blocky fruit with medium-thick walls.

Tomatoes. Several F_1 hybrids have consistently yielded more early fruit than any of the standard early varieties in our trials. One of these (Red Cloud x Pritchard) has been named "Red Jet" and seed has been distributed widely for trial in 1954. The hybrid Red Cloud x Pennheart continues to perform exceptionally well as a first early tomato. Perhaps the only drawback with this variety is its tendency to produce smaller tomatoes at the close of the picking season.

—*W. L. Lachman.*

Culture and Nutrition of Vegetables. Eighty F_1 hybrids and three standard varieties of onions were grown in the greenhouse and transplanted out-of-doors to determine their yielding ability and general adaptability. The fact that certain onions are F_1 hybrids does not by this point alone make them all important, because six of the hybrids yielded significantly less than the poorest standard variety in the test. On the other hand, five of the hybrids did yield significantly more than the highest yielding standard variety. One of the F_1 hybrids produced 38 percent more marketable onions than the best standard variety.

One of the difficulties ordinarily experienced in the culture of onions from sets is that from 10 to 20 percent of the plants bolt, ie., send up seed stalks. Since most onions that send up seed stalks fail to produce marketable bulbs, onion growers nip off the flower buds before they open. For many years it was felt that this practice reduced the number of thick-necked or undesirable bulbs, but now its value is considered questionable.

Onion sets subjected to warm storage at 86° F. for 5 to 9 weeks at the end of their storage period bolted significantly less than comparable sets kept at 32° F. throughout the storage period. The crop yield tended to be greater, and bolting was delayed more in sets given warm storage than in sets given cold storage only.

—*W. H. Lachman.*

Weed Control In Vegetable Crops. The application of fourteen treatments with chemicals in pre-emergence applications to a very weedy asparagus bed led to the conclusion that "Karmex W" was the most effective material yet tried for weeding asparagus. Karmex W at 1½ pounds per acre prevented all weed growth through the season without apparent injury to the asparagus.

In tests with a number of vine crops it is evident that some crops are damaged by Alanap-1. Cucumbers and muskmelons were relatively unharmed by pre-emergence applications of 2 to 4 pounds of Alanap-1., however, squash and pumpkins were harmed to a considerable extent with this treatment. Vegetable growers should expect applications of this chemical during dry weather to be of little value unless irrigation can be used in conjunction with it.

Eighteen pre-emergence treatments were applied in plots of sweet corn and best results were obtained where Premerge, a Dinitro material, was applied at the rate of 4½ pounds to the acre. This treatment may be applied directly after planting until the time the plants emerge. Corn plants in the spike stage, one-inch tall, may also be sprayed but at a rate of 3 pounds per acre. Corn sprayed in this manner remained free of weeds until the crop was 10 to 12 inches tall.

Of the many herbicides used in plots of beets, Chloro-IPC offers most promise as a selective weed killer in this crop. When 2 to 4 pounds of Chloro-IPC were sprayed on the plots immediately after planting, most weed growth was inhibited for a period of 3 to 4 weeks.

—*W. H. Lachman.*

Breeding and Cultural Problems of Greenhouse Vegetable Crops.

Greenhouse Tomatoes. The time-of-planting study being conducted with spring tomatoes was continued as in the past, except that the first plants were set January 20 followed by settings on February 1 and 15, and on March 1. The January 20 planting produced the most fruit, but the fuel cost was such that the February 1 planting was the most profitable. Because of differences in weather, yields, and prices, the spread between the best and poorest plantings was not as great as in other years.

The fall tomato crop was grown to determine whether leaf or top pruning would hasten maturity. The results indicate that the topping of the plants October 1 did not significantly hasten maturity or increase size.

Greenhouse Radish. With the development of a coring method of determining pithiness in radish roots, it was possible to reduce this defect 10 percent in one year and increase the percentage of No. 1 radish. Further selections are now being made.

—*Robert E. Young, Waltham.*

Vegetable Breeding For Improvement of Quality and Adaptability.

Lettuce. Several selections were compared in trials with many of the regular commercial varieties. One selection that has been carried for several years, intended for those growers transplanting early lettuce, continued to be early and uniform but may be too small. Wide scale

trials of this selection have been delayed because of failure of the seed crop.

Progress was made in the development of a better adapted strain of Great Lakes for local use. One large-scale trial showed this strain to be very well adapted for summer lettuce. Only after wide scale trials on many soils can the real value be determined. Failure of the local seed crop has delayed this trial, and seed has been sent to western seed-producing areas for increase.

Cabbage. The work of developing a small green cabbage that can be planted close together has progressed to where some selected lines are uniform and of a desirable type. Until plants can be found that will produce normal seed set, these lines cannot be given grower trials. Both spring and fall crops are being grown to enable a wider search for suitable selection with good seed setting characteristic.

—*Robert E. Young, Waltham.*

Asparagus Investigations. During the year more stock seed of Waltham Washington, a new variety developed in this project, was grown for distribution both for seed production and trials. Some commercial seed of this new variety should be available to the public in 1956.

Yield data were taken on 57 different plots, and the results were about the same as previously reported.

Efforts were made to develop a method of vegetatively propagating old asparagus crowns so that the plants selected to make up the Waltham Washington strain could be moved and preserved for future use. The results of these efforts to date have not been successful.

—*Robert E. Young, Waltham.*

Seed Improvement.

Trellis Tomatoes. The major portion of the tomato breeding work has to do with the development of crack resistance in trellis-type tomatoes. The crack resistance comes from the variety Crackproof which is a late-maturing variety. Resistance to cracking is loosely linked with late maturity. Lines have now been developed with half as much cracking as Trellis 22, and almost as early.

Hormone treatments on trellis tomatoes to improve the set and earliness were continued, and the results were about the same as reported last year. Very favorable increase in early fruit was obtained.

The investigations of different types of trellises and spacing for tomatoes were continued with results about the same as previously reported.

Carrots. Efforts to breed a dark colored carrot of the Hutchinson type have reached the point where one of the selections of this type is ready for extensive trial, and seed is available for these trials. Whether this carrot is smooth enough for critical trade is one of the points expected to be cleared up by these grower trials. Work on other lines was also continued.

Butternut Squash. Progress in the development of a more uniformly shaped fruit was concerned with new techniques of growing to insure a more thorough appraisal of the variation in inbred lines. There is a large amount of variation in the shape of squash grown on

the same plant, apparently because of changes in environment. Further study of the cause of this change in shape is now under way.

Greenhouse Tomatoes. The work of developing a greenhouse tomato larger than Waltham Forcing has continued, but the combination of the firmness characteristic with large size has not been achieved.

—*Robert E. Young, Waltham.*

The Effect of Simulated Hail Damage to Selected Vegetable Crops. This particular project is an attempt to establish a factor for degree of damage, at a given stage of growth, caused by simulated hail to such crop plants as potatoes, beans, and tomatoes. Simulation of hail injury to these crops is effected by a special machine by which wind, water, and ice (hail) can be applied in varying degrees or amounts.

Studies to date with potatoes and beans indicate only very slight reductions in yield or quality from foliar or stalk damage of varying intensity during the early vegetative period of growth. On the other hand, light to moderate plant damage during and after the bloom period not only reduces yields to an appreciable degree but also delays the maturity of the two crops under study.

Because of the interrelationship of so many factors involving weather, soil, and cultural practices to the time and degree of hail damage, further workis being carried on with potatoes and field beans.

—*Grant B. Snyder.*

DEPARTMENT OF POMOLOGY

A. P. FRENCH IN CHARGE

Influence of Chemical Treatments on Flowering and Fruiting. *Chemical Thinning of Apples and Peaches*: Experimental work was conducted in the University and in six commercial orchards on many apple and peach varieties to determine the comparative effectiveness of naphthaleneacetic acid (NAA), napthaleneacetamide (NA Amide), and 3-chloro isopropyl-N phenyl carbamate (CIPC) for post bloom thinning of the fruit. The use of CIPC was limited to peaches, however. Such factors as time, number, and method of application, concentration of materials, influence of materials on the foliage, and effect of the nutritional status of the tree were studied. Data on the influence of treatments on fruit set were obtained. In some cases data on fruit size, yield, and flowering in succeeding years were collected.

Results indicate that NA Amide may gradually replace NAA materials for thinning apples, if ways can be found to increase its thinning ability on certain varieties. NA Amide is a mild material which has caused no foliage injury at concentrations up to 50 ppm. In 1953, repeat applications of NA Amide (one at petal fall and another 10 to 14 days later) thinned McIntosh and Baldwin apples more than a single application at petal fall or later. This may be a method of increasing the amount of thinning obtainable when using NA Amide on such hard to thin varieties as Wealthy and Early McIntosh.

CIPC appears to offer some promise as an after-bloom peach thinner and it is apparently noninjurious to peach foliage up to 200 ppm. NA

Amide was also noninjurious to peach foliage up to 50 ppm., but it appears to be too mild a thinning material to reduce the set sufficiently on heavy setting varieties. NAA materials may thin adequately but often cause rather severe injury to the developing shoots.

Pre-harvest Drop Control: In 1953, comparative studies of 2,4,5-trichlorophenoxyacetic acid (2,4,5-TA),2,4,5-trichlorophenoxypropionic acid (2,4,5-TP), and NAA for pre-harvest drop control of McIntosh were made. All materials failed to control drop on trees that were prone to drop heavily. Failure of 2,4,5-TP and 2,4,5-TA (which have controlled drop for 3 weeks or more in other years) to control the drop of such trees may be related to the exceedingly dry weather experienced in 1953.

—*F. W. Southwick and W. D. Weeks.*

The Influence of Orchard and Post-Harvest Treatments on the Metabolism of Tree Fruits. Major emphasis was placed on attempts to determine the effect of 2,4,5-trichlorophenoxyacetic acid (2,4,5-TA) and maleic hydrazide used alone and in combination with each other on the rate of respiration and softening of apples grown at varying nitrogen levels. Results indicate that 20 ppm. of 2,4,5-TA is capable of hastening ripening of apples but to a much smaller extent than 2,4,5-trichlorophenoxypropionic acid (2,4,5-TP), another pre-harvest drop material. The ripening influence of 2,4,5-TA is much more pronounced on apples grown at high than at lower nitrogen levels. Sprays of MH are capable of inhibiting ripening of apples even when applied several weeks prior to harvest. Also, when MH is combined with 2,4,5-TA, the MH is able to reduce or eliminate the ripening influence of 2,4,5-TA. MH can apparently eliminate the ripening influence of 2,4,5-TA on apples grown at relatively low nitrogen levels but only reduce its ripening effect on apples grown on trees with a higher nitrogen status.

Storage studies were continued on Cortland and Rhode Island Greening to determine the influence of varying temperature on storage scald development. Composited samples of each variety were held for varying lengths and periods of time at 40° and 32° F. As in the previous test, scald was least prevalent when both Cortland and R. I. Greening were stored for 16 weeks at 40° F. as compared to similar fruit stored for 16 weeks at 32° F. However, fruits stored at 40° F. for 1- to 4-week intervals during the 16-week storage period (remainder of the time at 32° F.) did not always have less scald than fruits held continuously at 32° F. Cortland held for the first 2 to 4 weeks of their storage period at 40° F. developed less scald than other lots held at 40° F. for similar lengths of time later in their storage period. In contrast, R. I. Greening developed less scald when held at 40° F. for the last 2 to 4 week period than similar fruit held at 40° F. for identical periods of time earlier in their storage period.

—*F. W. Southwick.*

Study of Bud Sports of the McIntosh. The effect of different levels of nutrition on the development of fruit color was observed for seven strains of McIntosh apples. High nitrogen reduced the amount of

color on all seven strains, but the reduction in color was much less for the Rogers strain than it was for the striped strain. It appears that a highly colored strain such as Rogers may be grown at a higher nitrogen level without seriously reducing the amount of red fruit color.

—W. D. Weeks and F. W. Southwick.

The Nutrition of Apple Trees. McIntosh apple trees that had their fertilizer treatments changed from high nitrogen alone to medium nitrogen plus high potassium were found to have reduced leaf nitrogen and increased leaf potassium. Changing treatments from low nitrogen plus potassium to high nitrogen alone gave decreased leaf nitrogen and increased leaf potassium. Red fruit color was associated with the nitrogen and potassium content of the foliage. High color was associated with medium leaf nitrogen and high leaf potassium. Poor color was associated with high nitrogen and low potassium.

With the cooperation of the Control Service, a leaf analysis survey was conducted in 30 commercial McIntosh orchards. The survey indicated that magnesium was most frequently in low supply. Nearly one-half of the trees in the survey were below the desirable level. About 30 percent of the trees were below the desirable level for nitrogen, potassium, and calcium. Phosphorus content was generally adequate. The survey indicated the need of considering elements other than nitrogen in adopting a fertilizer program for Massachusetts apple orchards.

—W. D. Weeks, F. W. Southwick, Mack Drake, and J. E. Steckel, in cooperation with the Chemistry and Agronomy Departments.

Study of Tree Characters of Fruit Varieties. An unknown variety with similar vegetative characters to Lodi was found mixed with Lodi in two commercial nureseries this past season.

—W. D .Weeks, A. P. French, and O. C. Roberts.

Evaluation of Rootstocks for Tree Fruits. This project was initiated during the year to replace the Federal project on rootstocks. The more promising Malling stocks and the Malling Merton series will be tested for their adaptability to commercial orchards. Most of the test orchards will be in growers' orchards.

—W. D. Weeks.

Studies of Varieties of Fruits. Melrose continued to show promise as a winter apple. Spartan, a McIntosh seedling from British Columbia, appears to be worthy of extensive trial.

Low temperatures in January (–14° to –18° F.) gave an opportunity to evaluate the bud hardiness of several U.S. Department of Agriculture hardy peach selections. These selections were not any more bud hardy than hardier commercial varieties.

—W. D. Weeks and Staff.

Nature of Winter Hardiness in the Raspberry. Holding Latham raspberry canes at 40° F. for 3 to 5 days reduced their resistance to low temperature injury. Injury appears to be confined to cane tissue

and not to the bud, as frozen canes developed normal leafy shoots and flower clusters when forced in the greenhouse.

Chemical studies indicate that the hardy variety is characterized by greater toluene sorption, a less stable sol and a greater content of original moisture.

—*W. D. Weeks, J. S. Bailey, Emmett Bennett, and F. W. Southwick, in cooperation with the Chemistry Department.*

Blueberry Culture. Chlorotic blueberry plants treated in the Spring of 1953 with chelated iron or fritted trace elements have been very slow to show any response. Although all bushes in the field improved in appearance regardless of treatment, the bushes treated with chelated iron or fritted trace elements show improvement above average when compared with bushes that were equally chlorotic at the beginning of the experiment.

—*John S. Bailey.*

Improvement of the Wild Lowbush Blueberry. Since most of the weeds that are troublesome in fields of lowbush blueberries grow higher than the blueberries, it should be possible to apply chemicals to the weeds without getting them on the blueberries. In this way, material that would ordinarily injure blueberries could be used. Two methods for accomplishing this were tried: (1) A "drag cloth" was made by nailing pieces of burlap soaked in a concentrated solution of weed killer to a pole and dragging it over the weeds. (2) An applicator was made by nailing a light stick of wood about 18 inches long to the end of another piece about 4 feet long in such a way as to resemble a hockey stick. The shorter or lower part of this "hockey stick" was wrapped with rags soaked in concentrated weed killer. As the workman went across the field, the "hockey stick" was waved back and forth in such a manner that the weed killer came in contact with the weeds but not the blueberries. These two methods were used for applying 2,4-D, 2,4,5-T, and mixtures of the two to small poplars starting up among the blueberries. The "hockey stick" was a better method of application than the drag cloth. The 2,4,5-T was most toxic to both poplars and blueberries. An ester formulation of 2,4-D plus 2,4,5-T was second in toxicity to both poplars and blueberries. An amine form of 2,4,5-T was third in toxicity to poplars and caused some injury to blueberries. An amine form of 2,4-D plus 2,4,5-T was fourth in toxicity to poplars and caused some injury to blueberries. An amine form of 2,4-D was least effective on poplars and least damaging to blueberries. Each of the materials tried was either ineffective against poplars or too damaging to the blueberries.

Bracken, or brake (*Pteridium latiusculum*), is a very serious pest in many blueberry fields. Preliminary trials with polyborchlorate and CMU suggested that these materials might have value as selective herbicides against this weed although over-dosage would severely injure the blueberries. Polyborchlorate applied in mid-July at 600, 800, and 1000 pounds to an acre injured the blueberries severely but a year later the blueberries had recovered, and most of the bracken was gone from the treated plots. Therefore, in the Fall of 1953 polyborchlorate

was applied at 400, 600, 800, and 1000 pounds to an acre to some fields that would be cropped in 1954 and to some that would be burned in 1954. In June 1954 it appeared that an application of polyborchlorate in the fall preceding the cropping year would result in the loss of the crop. Amounts in excess of 600 pounds to an acre are too injurious to the blueberries; the bracken was not controlled on all plots, but the full effect of the polyborchlorate was probably not yet apparent.

CMU applied in August or April at 5, 10, 15, and 20 pounds to an acre was a bit erratic both as to bracken control and injury to blueberries, but further trial seemed desirable. In the Fall of 1953 it was applied at 5, 7 ½, 10, 12 ½, and 15 pounds to an acre to fields that were to be fruited in 1954 and to some that were to be burned in 1954. In June of 1954 no effects on either weeds or blueberries were apparent on any of the plots.

—*John S. Bailey.*

Chemical Control of Weeds in Fruit Plantings.

Cultivated Blueberries. CMU was applied in March around cultivated blueberries at 2, 4, 8, and 12 pounds to an acre. Results were variable. In the presence of a tough quackgrass (*Agropyron repens*) sod it had little effect on either weeds or blueberries. Where the infestation of quackgrass was light to moderate, 8 pounds of CMU gave fairly good control of weeds without injury to blueberries. Twelve pounds gave very good control of weeds but injured the blueberries rather badly.

In December 1953, CMU was applied at 8, 9, 10, and 11 pounds to an acre, polyborchlorate at 400, 600, 800, 1000, and 1200 pounds to an acre, and Chloro IPC at 10, 20, 30, 40, and 50 pounds to an acre in fields where there was a tough quackgrass sod. CMU hurt neither grass nor blueberries. Polyborchlorate hurt the blueberries at the two highest rates and gave very little grass control at any rate. Chloro IPC did not injure the blueberries at any rate. Increasing control of quackgrass was obtained as the amount of Chloro IPC was increased. Fifty pounds to an acre gave about 95 percent control.

Strawberries. Overdosing with SES, Crag Herbicide #1, on a very light sandy soil caused severe injury to strawberries. On a medium heavy soil 6 pounds to an acre did not injure strawberries. Sesin, a material similar to SES, gave slight weed control at 3 pounds to an acre but gave fairly good control at 4, 5, or 6 pounds to an acre. When applied in the fall, neither SES nor Sesin were effective against common chickweed (*Stellaria media*). Very good chickweed control was obtained when Chloro IPC was used at 2 pounds to an acre the first week in October when the chickweed was small. Later in the season it required 3 pounds to an acre or more to get equally good results. Best control in mid-November was obtained by using a combination of 2 pounds of Chloro IPC and 1 pound of dinitro weed killer to an acre. This resulted in almost complete eradication of the chickweed.

—*John S. Bailey.*

The Development and Production of Healthy Strawberry Plants. For years strawberry growers have complained that their plants "run

out." We know now that this decline in vigor is the result of virus infection. Virus-free plants of four varieties are being compared with ordinary plants of the same varieties at several different places in the state. Frequently, the superior growth of the virus-free plants was evident in a month or six weeks after planting.

Black root is an old and rather common disease of strawberries. It is now thought to be related to the presence of meadow nematodes, *Pratylenchus penetrans*, in the roots of the strawberry plants. In the Fall of 1953, strawberry plants were obtained from 24 fields where black root trouble was suspected. These samples came from eight of the fourteen Massachusetts counties. Meadow nematodes were found in 20 of the 24 samples. Soil fumigation experiments were begun in the Fall of 1953 using D-D and ethylene dibromide. In the Spring of 1954, strawberry plants of four varieties were set on these fumigated plots and on adjacent unfumigated land. Some of these plants were virus-free and nematode-free; some were virus-free, and some were ordinary plants assumed to be virus infected and probably nematode infested. By mid-June, differences in vigor were appearing not only between virus-free compared with ordinary plants but also between nematode-free compared with nematode-infested among the virus-free plants set in fumigated soil.

—*John S. Bailey.*

The Cause of Unfruitfulness in the Beach Plum. There are only a few named varieties of beach plums, and the plant supply of these is extremely limited. It is, therefore, desirable to propagate these as rapidly as possible. Attempts to get own-rooted beach plums by the short root-long scion method using root pieces of *Prunus mahaleb* were unsuccessful. Budding on *Prunus mahaleb* stocks was only partly successful. In the Fall of 1953, a small planting of named selections of beach plums was set out at the Cranberry Station at East Wareham.

It was hoped that an application of fertilizer would increase the set of beach plums. Applications of a commercial 7-7-7 fertilizer at rates of 250, 500, 1000, or 2000 pounds to an acre had no effect on fruit set or terminal growth, and little, if any, effect on yield the first year of application. Nitrogen applied as ammonium nitrate sufficient to give 200 pounds of nitrogen to an acre greatly increased shoot growth.

Since brown rot often reduces plum yields by destroying the blossoms or rotting the fruit, spraying experiments were conducted to control it. Either wettable sulfur or fermate reduced brown rot to less than one percent at harvest time. After three weeks in cold storage, fermate-sprayed fruit had no increase in brown rot; sulfur-sprayed fruit had about 12 percent brown rot, and unsprayed fruit was half rotten. Wettable sulfur caused a minute pitting of the skin, which is undesirable.

Hand-pollination resulted in poorer set than open-pollination. Pollen was very difficult to collect in the field most of the time. It could be readily obtained by bringing flowering branches into a warm, dry room. Insect activity appeared to be sufficient to affect satisfactory natural pollination.

—*John S. Bailey.*

DEPARTMENT OF POULTRY HUSBANDRY

FRED P. JEFFREY IN CHARGE

Rhode Island Reds Now Bred for Complete Freedom from Broodiness. This line has now been tested through five complete generations with no evidence of the broody instinct. Because of limited facilities some inbreeding has been necessary so that the average degree of inbreeding is about 12 percent. Mortality rates approach the 40-percent level during the first laying year without culling. Mean egg production of survivors is about 200. In hatchability the mean is about 80 percent. The birds in this line are being slowly improved by rigid selection, and their value for crossing with the portion of our flock bred for high fecundity as well as with other strains is being investigated. Limited mating indicates a high degree of superiority in some of these birds in breeding for high fecundity. Birds in this line are useful for crossing because they never increase the incidence of broodiness over that of another stock used in a cross.

—*F. A. Hays.*

Breeding for High Fecundity in a Closed Flock. High fecundity in poultry is known to depend on a wide array of physiological activities, and the study of a closed flock affords much valuable information to the practical breeder.

Among the problems that have been studied during the past year is viability. We have shown that age of parents does affect viability of chicks for the first eight weeks of life, but that this effect does not persist after eight weeks either in the growing period preceding sexual maturity or in the pullets during their first laying year. The mortality rate of pullets in the laying house is independent of egg production. Viability in the laying house has a very low degree of heritability in this flock. Calculations show a value of about 4 percent.

An excessive number of male chicks have been observed in this flock for many years. An extensive study of our data indicates that as the age of sires increases, the percentage of male chicks in families increases. Dams with high embryonic death rates in their offspring generally produce an excess of male chicks because of a higher death rate in female embryos.

Methods of breeding to determine the effects of over-dominance and epistasis are being applied. Thus far, no conclusive evidence of either has appeared, even though the flock does not respond satisfactorily to selection pressure where calculations show a heritability of about 18 percent for egg production of survivors. Strain crosses within the Rhode Island Red breed have not been satisfactory thus far. One breed cross produced pullets with most superior egg production and improved viability. A new strain of Rhode Island Reds was brought in this year to secure further data on the practical value of strain crosses.

—*F. A. Hays.*

Selective Breeding Increases or Decreases Hatchability. Eight generations of selective breeding have given two lines that differ significantly each year in hatchability. We have been searching for

the causes of this difference. General results indicate no recognizable lethals but the "low" line consistently gives a high embryonic death rate during the first five days of incubation. The evidence suggests that these early embryonic deaths are largely caused by malnutrition, possibly defective circulation. The general viability of surviving birds in the "low" line is much below that of the "high" line.

The "high" line has attained a mean hatchability of 94 percent, and little difficulty has been experienced in maintaining a high level of hatchability. The stock in this line is for the most part superior in laying ability.

Heat Tolerance and Thermoregulation in Domestic Fowl. A series of experiments has been conducted involving the effect of injected d.l. thryoxine on survival time under thermal stress. A factorial design was utilized involving the following treatments: Thyroxine, Sex, and Breeds (White Rock and S. C. White Leghorn). With this method, the interactions among treatments could be studied, and additional verification of previous work involving breed and sex differences obtained. These studies provide substantial evidence that metabolic rate is one of the primary factors influencing survival time under high environmental temperatures.

—Thomas W. Fox.

The Interrelationship of Growth with Other Physiological Factors of Chickens. In many selection experiments the application of artificial selection for one trait results in correlated responses in one or more other characteristics. Two lines have been established for high and low rate of growth and have been submitted to one generation of selection. The selected parents of the present generation exhibited the following differences between lines: The individuals of the high line matured earlier, were heavier for both adult weight and egg weight, and were superior in viability to the low line. Growth data on the present generation will provide the first estimates of heritability from actual progress made in separating high and low growth rate lines. Very preliminary estimates based upon a portion of the present generation indicate a heritability of 30 to 40 percent.

—Thomas W. Fox.

Value of Milk as a Diluent of Semen of the Domestic Cock. Five fowl semen diluents have been tested for ability to support duration of fertility. These diluents included boiled pasteurized milk, pasteurized milk, boiled skimmilk, skimmilk, and semen serum. All diluents tested caused a greater percentge of completely infertile inseminations. Whole semen, semen diluted with semen serum, and semen diluted with boiled pasteurized milk induced approximately equal duration of fertility in fertile hens. Boiled pasteurized milk supported a more satisfactory duration of fertility than pasteurized milk, boiled skimmilk, or skimmilk.

Dosages of 0.033 c.c. and 0.05 c.c. of whole semen were also compared to the commonly recommended level of 0.1 cc. The 0.05-cc. level supported satsifactory fertility, but there was some evidence of a

larger number of completely infertile inseminations when 0.033c.c. of semen was used.

—*Richard Koski and Thomas W. Fox.*

Effect of Progesterone on Body Weight and Growth of the Domestic Fowl. Two experiments testing the effects of graded weekly injections of progesterone on body weight, shank length, and comb size have been conducted with male and female S. C. White Leghorns 4 to 16 weeks of age. Also, testis weight was studied in males and onset of sexual maturity and adult weight in females. The results indicate that progesterone has little or no effect on growth rate as measured by mean body weight. Average skeletal growth determined by shank length measurements was also unaffected by treatments. However, the variation in body weight and shank length as measured by the coefficient of variation was increased by progesterone treatment. This increase in variation was directly related to the dosage. Progesterone caused a depression of comb and testis development and substantially delayed the onset of sexual maturity in females. The possibility of an androgenic effect of progesterone was investigated with capons and yielded negative results.

—*Thomas W. Fox*

Mating Activity in the Turkey. The mating activity of 80 female turkeys representing the third generation of selection for high and low mating frequency was tested over a 13-week observation period. This latest test showed that the two lines definitely differ in this respect. These selection results to date demonstrate that sexual receptivity or mating frequency in the female turkey is an inherited characteristic. It has not been possible as yet to test enough males of the two lines to indicate whether or not their mating activity has been changed by the selection applied on the females. The evidence that mating frequency in the female turkey, previously shown to be an important component of fertility, is an inherited characteristic offers a possibility of improvement to turkey breeders plagued with low mating frequency stock.

A factorial experiment designed to test the effects of diethylstilbestrol and progesterone on mating frequency of the female turkey was also conducted. The treatments were introduced between April 6 and April 20, 1953. Neither of the hormonal substances had any significant effect on mating activity, egg production, or hatchability at the levels employed and at the period of time that they were administered.

—*J. Robert Smyth, Jr.*

Effect of Diethylstilbestrol in a Salve Base on Growth and Market Quality of Turkey Broilers. A study was made of the effects of the administration of 10 mg. of diethylstilbestrol suspended in a salve carrier (Tend-A-Wate, Mattox, and Moore, Inc.) to eight-week old turkey broilers on subsequent growth and market quality. Four pens, each containing 15 males were treated, while a similar number of pens and birds were maintained as controls. Growth rate differences at 11

and 12 weeks of age in favor of the treated birds were statistically highly significant. A significant difference in the improvement of the fat finish of the treated birds was also noted when the birds were slaughtered at 12 weeks of age. The improvement in fat finish alone warrants the use of diethylstilbestrol for turkey broilers. The additional growth rate stimulus makes diethylstilbestrol, at least when suspended in a salve base, an extremely valuable aid to commercial turkey broiler production.

—*J. Robert Smyth, Jr. and John H. Vondell.*

Hatchability during the First Six Weeks of Egg Production in the Domestic Fowl. It was previously found that the hatchability of fertile eggs laid during the first six weeks of egg production was 10 to 15 percent lower than it is after the birds have been in production for several months. The situation was found to exist for White Leghorns, White Plymouth Rocks, and for two strains of New Hampshires. That the female is the cause of this high rate of embryonic mortality was established by the failure of males of differing ages to influence this condition. The reduced female reproductive efficiency was not found in Rhode Island Red females when they resumed production after a nonproductive period during their first fall moult. This indicated that the problem is closely associated with female immaturity and not the result of some physiological unbalance due to the onset of egg laying after any extended ovarian quiescent period. An analysis of data involving 700 New Hampshire pullets at Nichols' Poultry Farm, Kingston, New Hampshire, on the basis of sire and dam families indicated a heritable basis for the reduced reproductive efficiency of the immature female. Poultry breeders who utilize all pullet eggs for hatching purposes should be able to eliminate the hatchability problem associated with immaturity by selective breeding.

—*J. Robert Smyth, Jr., Thomas W. Fox, and H. C. Hutchings.*

Inheritance of an Abnormal Type of Plumage in the Turkey. An abnormal type of plumage in the turkey was found on several different turkey breeding farms. This condition has been named "hairy." A detailed macroscopic and microscopic description of this condition was made. Appropriate matings showed that hairy plumage was inherited and was due to a single autosomal recessive gene. Hairy poults hatch and live as well as normal poults when reared under favorable conditions and separately from normal individuals. However, viability of the hairys is reduced when they are reared under commercial conditions. Since hairy poults are easily identified at hatching time, they must be classified as cull poults. Their presence represents a loss to the commercial turkey breeder. One breeder reported an incidence of 2 percent hairy poults. By using simple test crosses, based on the knowledge of the inheritance of this condition, the hairy gene can be eliminated from a breeding flock.

—*J. Robert Smyth, Jr.*

Genetics of the Length of the Incubation Period in Chickens. Previously, two lines of White Plymouth Rock chickens differing in the time required for complete embryonic development and emergence from the egg have been established by selective breeding. However, in the latest or fourth generation of selection, neither the difference in hatching time nor the mean egg weight between the two lines was changed. The difference in emergence time between the lines amounted to 20.8 hours in the fourth selection generation. The egg weight difference was 1.7 grams with the late emergence line having the larger average egg size.

—*J. Robert Smyth, Jr.*

Sperm Survival Time in the Female Reproductive Tract of the Fowl. The earlier selection for high and low duration of fertility lines in White Plymouth Rock chickens was based solely on ratings in this respect for the females in the two lines. Progress under this method was disappointing. In an attempt to increase the efficiency of selection, males were pretested as well as the females during the 1952 season. Two hundred and fifty females and 60 males representing the first generation of selection involving both sexes were tested. The average duration of fertility in the high line was 12.2 days, and that of the low line was 9.3 days. This difference is encouraging and indicates that adequate selection pressure may now be available for continued genetic progress in differentiating the two lines. The progress made in the last generation supports the previously suggested idea that the time that sperm cells can survive in the female reproductive tract involves two distinctly different sex-limited characteristics.

—*J. Robert Smyth, Jr.*

Mating Activity in Inbred Lines of White Plymouth Rock Chickens. Lines differing in mating activity have been selected along with the development of inbred families of White Plymouth Rock chickens. During the past year, 58 males and 160 females were tested by ½-hour stud mating tests. Each male was tested five times, and the incidence of mating for each female was recorded for 24 one-half hour trials. These birds represented the second generation of selection. Wide differences already exist between the high and low mating frequency lines. The high line females mated four times as frequently as did the low line females. Differences were also found between the males of the two lines. The high line males attempted twice as many matings on the average as did the low line males. Since mating activity is an important component of fertility, this provides additional evidence that fertility is inherited.

—*J. Robert Smyth, Jr. and Fred P. Jeffrey.*

Normal Spermatogenesis in the Turkey. To study the normal steps involved in testis development and spermatogenesis in young turkey males, histological observations of testes material were studied at appropriate intervals. Ten left testes were sectioned, stained, and examined from males at one day of age and at 6, 12, 16, 18, 20, 22, 24, 26, 28, and 39 weeks of age. In addition to the histological data,

measurements were taken of testes size and average seminiferous tubule diameter. From these data it was possible to establish the mean age of the appearance of primary spermatocytes, spermatids and spermia. In all cases where data were available the left testis of the turkey was larger than the right. To supplement the histological picture, approximately 45 toms were maintained and subjected to weekly tests for the presence of ejaculated semen. A close agreement between the mean age for the appearance of free floating spermia in the tubules and actual semen production was found.

—*J. Robert Smyth, Jr. and B. N. Levis.*

DEPARTMENT OF SHADE TREE LABORATORIES

MALCOLM A. McKENZIE IN CHARGE

General Program. More than 9000 specimens were examined in laboratory and field tests, including 51 fungus diseases of 34 species of trees. Injury to trees from dirt fillings involved in grading operations and construction work of all kinds, especially housing programs, is a common cause of complaints. Damage initiated in this way is often erroneously attributed to other factors, since early effects of fill are easily overlooked. Also, the individual reporting tree damage may not have any knowledge that fill was used in a given area if the work was completed prior to his interest in the site. Other nonparasitic troubles investigated include gas injury, lightning damage, ice-storm breakage, winter dieback, frost killing, and drought effects.

Resignations of Dr. David H. Marsden and Dr. Philip L. Rudsen, currently in key positions in Amherst and Waltham, respectively, have seriously interrupted progress of research and other phases of the program of Shade Tree Laboratories. By appointments now in process to fill these vacancies, the operation of the full program at an early date is anticipated.

Dutch Elm Disease Control Testing. From June 1, 1953, to June 1, 1954, the Dutch Elm disease was found in samples from 17 additional towns, making a cumulative total of 308 towns of 351 towns in Massachusetts involved since the disease was first known here (1941, Alford, Berkshire County.) Summarily, in laboratory studies by means of tissue plantings in artificial culture media, the disease fungus, *Ceratostomella ulmi* (Schwarz) Buisman, has been isolated from 23,711 trees (June 1953-1954, 5590) in all 12 counties on the mainland, Dukes and Nantucket being reported as disease-free at present.

—*M. A. Mc Kenzie, D. H. Marsden, R. L. Coffin, H. S. Clark, J. S. Demaradzki, T. W. Mannett, J. Maspero, J. G. Moline, M. M. Hart, and M. K. O'Donnell.*

Oak Wilt. Recently, the National Oak Wilt Committee and the Federal Government have issued circulars and press releases urging all persons whose activities bring them in contact with oak trees to send specimens of oaks suspected of the oak wilt disease to their respective

State Experiment Stations. This impetus has accentuated interest in the demands for increased research on oak diseases in Massachusetts.

The only attention given to oak diseases has been limited field examination which has now been critically curtailed to conform to other commitments of the shade tree program. At present, samples from oaks suspected of the oak wilt disease are tested by these Laboratories whenever specimens are received. Laboratory tests are necessary to establish the identity of the causal fungus (*Endoconidiophora fagacearum* Bretz.) Because the wilt is somewhat confused with other fungus diseases or tree troubles that resemble the wilt but do not constitute serious threats to oaks, property owners, and industries.

The oak wilt disease is not known to be present in Massachusetts, but it is serious in 18 States. The area nearest to Massachusetts in which oaks are known to be afflicted is Central Pennsylvania. All species of oak are affected. Because of the nature of the disease and the control measures now employed with some success, early detection of possible diseased trees in Massachusetts is imperative in view of the value of oaks to the Commonwealth.

—*M. A. Mc Kenzie.*

Needle Blight of White Pine. White pines in all parts of Massachusetts have shown a browning of needle tips on 1954 growth. Ordinarily, the browning includes about one-half of the needle beginning at the tip end. Trees of all ages are involved, and new growth is uniformly affected, but individual trees rather than entire stands are hit. In fact, foliage of two adjacent trees may be respectively uniformly browned or green throughout. The blight varies somewhat in appearance from the typical so-called winter injury type of damage and also is distinct from needle-drying by wind. Needle-drying is commonly limited to one side of a tree, and the uniform involvement of new growth is different from typical winter injury. Possibly the extended period of drought in the Summer of 1953 may be a primary factor, involving reduced water intake by roots and subsequent leaf bud damage. This type of needle blight is not new, but sometimes a period of 10 years may elapse without significant evidence of damage. This year, observation of the trouble is inescapable. The cause has never been definitely established.

—*M. A. Mc Kenzie.*

Leaf-Blister of Oak. Almost all species of oak were affected by a fungus disease in which numerous blisters cause conspicuous distortion of the leaves. Disease outbreaks in all parts of Massachusetts occurred early in the 1954 growing season. Although the causal fungus (*Taphrina coerulescens* (D & M) Tul.) is present every year, it rarely causes damage of sufficient importance to attract notice. In 1954, however, extensive early damage and defoliation occurred. A combination of circumstances may well be the explanation. Record-breaking spring rains timed to follow a warm period paralleled the unfolding of leaves and also the development of fungus spores in such a manner that heavy infection was facilitated. There is only one infection period. Control is practical, when necessary, by a single but

thorough application of a fungicide any time after leaves fall and before buds swell.

— *M. A. Mc Kenzie.*

Ash Rust. The complete or partial defoliation of red, green, and possibly other species of ash trees during the month of June, 1954, is chiefly a result of infection by a rust fungus (*Puccinia peridermiospora* (Ellis & Tr.) Arth.). The presence of the fungus is rarely observed until it has developed materially on the leaves, petioles, and twigs. The orange-colored spores produced in spots on affected parts cannot reinfect ash trees directly. The life-cycle of the fungus can be continued only if the alternate host plants, marsh and cord grasses (*Spartina* spp.), abundant along the seacoast, are available. If establishment on the grasses is accomplished, the fungus normally produces spores thereon, which at maturity are capable of infecting ash trees, especially if conditions favorable for spore distribution and germination prevail in the vicinity when leaves of ash trees are unfolding. Applications of wettable sulphur while foliage is developing might be valuable in limiting fungus infection, although experimental data are meager on this subject. Also, if conditions permit the destruction of the grass hosts of the fungus, ash trees in the vicinity will be protected. Otherwise, there is no satisfactory control for the disease on ash in locations near marshes known to harbor the grasses in large quantities. The planting of ash trees is inadvisable in such locations.

—*M. A. Mc Kenzie.*

Anthracnose of Hardwoods. Sycamores, oaks, and maples in particular, but also other species, have been damaged by heavy fungus infection throughout tissue of developing leaves in 1954. Before reaching full size, new leaves may be destroyed by the penetrating fungus, and early defoliation is common when heavy early infection is favored by wet weather. Control measures which must be undertaken before it is possible to determine whether infection may be serious include the application of a fungicide when new growth starts and at intervals of 2 weeks until 3 applications have been given.

—*M. A. Mc Kenzie.*

Leaf Spot Diseases. Red, brown or yellow spots ranging from $\frac{1}{4}$ inch in diameter to tiny pinpoint dots on many species of broad-leaved trees have occurred on 1954 leaves as a result of fungus infection. Ordinarily, infected leaves do not suffer extensive damage, but this year infection has been sufficiently heavy on box elder and some other trees to cause partial defoliation in early summer. If control measures are needed, the same treatment outlined for anthracnose may be followed.

—*M. A. Mc Kenzie.*

Maple Wilt. A disease of maple, which kills individual limbs or entire trees, has appeared at widely scattered locations in Massachusetts more or less regularly every year, but it has been found to an increased extent during the past year. Norway maples are most severely affected

and are commonly killed when infected by the causal fungus, *Verticillium* sp. The disease is often confused with a number of other maple troubles. Diagnosis is complicated by the fact that the greenish streaking characteristic of fungus infection may be restricted to the tree trunk or base instead of spreading uniformly into branches bearing wilted leaves. Also green color in maple wood is not necessarily a result of infection by the true wilt fungus. Not all afflicted trees die, but predictions on this point are hazardous. In individual trees, sometimes infection may be restricted by severe pruning.

—*M. A. Mc Kenzie, D. H. Marsden, R. L. Coffin.*

Town Tree Surveys. An outline report form has been prepared for trial in tree surveys with selected towns. The purpose of this report is to present a simple, practical method by which volunteer teams of two or three persons can survey the public shade trees. The proposed survey should result in a fairly detailed inventory by species, diameter class and condition of health of all trees close to or overhanging the public ways of the town. The final summarization of the data should indicate the number of trees that should be removed and the number requiring light, medium, or heavy pruning. In addition to the summary of data a series of maps will be made from which a tree map of the entire town may be prepared if so desired.

—*P. L. Rusden, C. S. Chater.*

DEPARTMENT OF VETERINARY SCIENCE

K. L. BULLIS IN CHARGE

Poultry Disease Control Service.

1. *Pullorum Disease Eradication.* During the 1953-54 testing season 1,195,159 blood samples, collected from 338 flocks, were tested for pullorum disease. The number of samples tested was slightly greater than the previous season. The percentage of positive tests (0.004) was the lowest in the testing history for Massachusetts. Only two flocks, which were negative the previous year, revealed reactors. At the close of the season, three flocks were classified as infected. Of the total birds tested, 99.39 percent were in nonreacting flocks. No reactors were detected in 34,779 tested fowl other than chickens. A total of 36,133 samples was tested for fowl typhoid. The testing results will be reported in more detail in the Thirty-fourth Annual Report of Pullorum Disease Eradication in Massachusetts.

2. *Diagnostic Service.* The primary purpose of the two diagnostic laboratories is to aid members of the poultry industry by furnishing accurate and complete diagnosis of disease outbreaks, to recommend appropriate treatment when indicated, and to encourage management practices that will minimize disease problems. An opportunity is also afforded to gauge the effectiveness of recommended control measures, to judge the needs and objectives for allied research, and to study health problems under natural conditions. The volume of specimens examined was greater than that of any previous year.

AMHERST. A total of 4,370 specimens was submitted for examination in 853 consignments. The specimens were classified as follows: 4,053 chickens, 155 turkeys,52 chinchillas, 25 each of oxen and swine, 14 sheep, 9 pigeons, 6 dogs, 4 each of ducks and mink, 3 each of goats and rabbits, 2 each of grosbeaks, parakeets, pheasants, robins, ruffed grouse, and feed samples; and 1 each of horse, cat, muskrat, and partridge.

WALTHAM. A total of 9,943 specimens was submitted for examination in 1,445 consignments. The specimens were classified as follows: 8,716 chickens, 989 turkeys, 62 guinea pigs, 53 ducks, 35 rats, 21 pheasants, 13 canaries, 12 quail, 9 rabbits, 7 each of parakeets and pigeons, 6 geese, 3 lorikeets, 2 monkeys, and 1 each of macaw, magpie, ruffed grouse, and sloth.

The most prevalent chicken diseases were infectious bronchitis, chronic respiratory disease, Newcastle disease, coccidiosis, and neoplastic diseases of the leukosis group.

A neoplastic process in turkeys indistinguishable from the visceral form of leukosis in chickens was observed. To our knowledge this form of the disease has not been reported in this species before. This may signify an adaptation of the causative virus to a foreign host.

3. *Histopathology.* There were 412 histopathological accessions in 1953. A species summarization of these accessions follows: avian—chicken (288), turkey (21), other (11); mammalian—chinchilla (33), porcine (17), bovine (9), canine (9), ovine (6), and other (18).

An economically important hemorrhagic syndrome of growing chickens has been recognized during the past three years. The disease

has occurred most frequently in large broiler flocks 5 to 12 weeks of age. Losses up to 40 percent have been reported. Postmortem findings include small hemorrhages at various sites in the bird, suppressive bone marrow alteration, and terminal necrosis of portions of the viscera. To date the cause of this condition is unknown. Many of the tissue changes do not appear to be related to vitamin K deficiency, nor in our experience have affected flocks responded after orally administered vitamin K (Menadione). There is some circumstantial evidence that the condition is aggravated in field cases by certain anticoccidial drugs. Prolonged medication in the feed with a drug of this type has not reproduced the condition. The disease did not develop when multtiple oral dosages of benzene were given. Thus far, experimental work has not duplicated the field condition. No infectious agent has been definitely associated with the disease.

Histological evidence of *Toxoplasma*, an obscure protozoan parasite, was found in a yearling hen of the Agricultural Experiment Station flock. This organism has a wide range of pathogenicity; fatal cases of the disease have been reported in dogs, cats, sheep, laboratory mammals, and man. In 55 serum samples taken one year later from two-, three-, and four-year-old birds in this flock, all were negative except five. The testing was conducted by Dr. C. R. Cole of the Department of Veterinary Pathology, Ohio State University.

An unusual condition characterized by doughy swelling of the wattles and the skin and subcutaneous tissue of the abdominal region was observed in two flocks of White Leghorn chickens. Microscopic sections of these tissues suggested a lipoid storage disease, *Xanthomatosis*, and gave a positive Schultz test for cholesterol. Prof. John W. Kuzmeski, Feed and Fertilizer Control Services, reported that the cholesterol content of affected tissue was between 2.5 and 2.8 percent. This is in excess of fifteen times the normal amount.

4. *Bronchitis.* A total of 1,194 flocks, representing 3,136,588 chickens, was enrolled in the infectious bronchitis control program during the 1953 calendar year. There were 1,640 requests for bronchitis virus. The flock inoculation results were as follows: 1,156 flock inoculations revealed takes, 188 inoculations yielded no takes, and no reports were received concerning 296 inoculations. In general, the results were very satisfactory. Very few breaks in immunity were observed. Also during the past calendar year, infectious bronchitis and Newcastle disease immunity tests were conducted on 101 and 292 flocks, respectively.

5. *Chronic Respiratory Disease.* Seventy-eight consignments from 69 flocks manifesting respiratory difficulties were selected for investigation relative to their etiology and pathology during a twelve months' period. The majority of cases were selected after respiratory symptoms had been apparent for two weeks or longer. Age of the birds ranged from four weeks to beyond sexual maturity. In approximately 50 percent of the cases, respiratory symptoms continued after infectious bronchitis "takes" or natural outbreaks of infectious bronchitis. Mortality in young birds was more severe when the respiratory disease was complicated with a secondary infection. Mature birds suffered little, if any, mortality. Chronic respiratory disease was identified in

61 of 69 flocks by bird and embryo inoculations. Newcastle disease virus was isolated from two-thirds of the cases. Secondary bacterial infection (*E. coli* most frequently) was observed in 21 cases. Pathologic findings revealed that reaction patterns were very similar for natural and experimental infections, but differed quantitatively.

During the past year, egg transmission studies of the chronic respiratory disease agent in a pedigreed, infected breeding flock have revealed that the disease can be perpetuated from one generation to the next via the egg route. Further chemotherapy studies have substantiated that antibiotics and other chemical substances exert little or no inhibitory influence on the chronic respiratory disease agent in the host.

—*H. Van Roekel, G. H. Snoeyenbos, G. P. Faddoul, J. E. Gray, M. K. Clarke, O. M. Olesiuk, C. F. Smyser, Jr., N. L. Shipkowitz, C. D. Brandt, G. W. Fellows, R. A. Bennett, and L. P. Beninato.*

Mastitis Testing Laboratory. Laboratory testing has proved of value in the State institution herds and in privately-owned herds that have availed themselves of the service. During the calendar year of 1953, a total of 28,079 milk samples was tested. Of this number, 17,764 were from 18 State institution herds, 723 from the University Farm Department herd, and 9,592 from 90 private herds.

The incidence of *Streptococcus agalactiae* infection in the State institution herds has been reduced from 38 percent of the cows, when 19 of 22 herds were positive in 1947, to 1 percent at the end of 1953. By 1951, 4 herds had been dispersed, and of the 18 herds remaining, 9 were positive. At the beginning of 1953, however, these herds were still positive, and the practice of making specific recommendations with each report was begun. Before the end of the year, all but one of the herds were freed of the infection. Success resulted when cooperation was obtained for an intensive program of testing, treating, and retesting. A herd was considered free when all *Streptococcus agalactiae*-positive cows had been found free on their last three tests.

Nocardia sp. infection of the udder was studied for several months in two cows obtained from a herd in which five cases were detected. Microscopic examination of the milk samples did not reveal the organism, and culture of the organism required longer than usual incubation of inoculated media. Both acute and chronic mastitis were observed. The secretion from affected quarters was abnormal and the amount was drastically reduced. Certain drugs were shown by sensitivity tests to be effective against the organism, but various udder infusions that were tried failed to remove the infection. Upon postmortem examination the infection was found only in the udder.

The brucella ring test is a screening test used extensively in several states to stimulate interest in eradicating brucellosis and to reduce the cost of the program. Brucella ring testing was done in cooperation with the current control effort of the State Division of Livestock Disease Control and the Animal Disease Eradication Branch of the United States Department of Agriculture. Tests were begun late in the year and were conducted on the market milk of these dairy-

men who had agreed to have a herd blood agglutination test if the ring test gave a suspicious reaction. Samples submitted by 33 patrons of 3 dairy plants were tested. Three were negative. This work is being continued.

—*W. K. Harris and I. M. Reynolds.*

PUBLICATIONS

Research in Review. Vol. 3, No. 1. January 1954.
Research in Review. Vol. 3, No. 2. June 1954.

BULLETINS

471 The Life History and Control of Euonymus Scale in Massachusetts. William W. Cantelo. 32 pp. November 1953.
473 The Biology and Control of *Lygus Campestris* L. on Celery. Warren D. Whitcomb. 16 pp. March 1954.
474 Number and Distribution of Dairy Cows and Young Stock by Counties and by Size of Herds, in Massachusetts. David Rozman. 40 pp. March 1954.
475 Annual Report for the Fiscal Year Ending June 30, 1953. 92 pp. June 1954.
476 Egg Pricing on the Boston Market. Alfred E. Brown. 64 pp. March 1954.
477 Grass Silage—A Reappraisal. J. G. Archibald, M. L. Blaisdell, G. Gersten, and D. M. Kinsman. 24 pp. June 1954.

CONTROL BULLETINS

156 Thirty-third Annual Report of Pullorum Disease Eradication in Massachusetts. Poultry Disease Control Laboratory. 12 pp. September 1953.
157 Inspection of Commercial Feedstuffs. Feed Control Service Staff. 38 pp. October 1953.
158 Inspection of Commercial Fertilizers and Agricultural Lime Products. Fertilizer Control Service Staff. 24 pp. December 1953.
159 Seed Inspection. Seed Control Service Staff. 32 pp. February 1954.

METEOROLOGICAL BULLETINS

775-788 Monthly reports of daily weather records including monthly and annual summaries. R. K. Patterson and I. J. Pflug. 4 pp. each.

Reports of Investigations in Journals

843 Studies of the biotin requirement of the rat. W. Litsky, S. Katsh, B. S. Tepper, and J. Alpern. Growth 17:81-86. 1953.
850 The effects of antibiotics on the bacterial plate counts of normal raw milk. E. I. Stoltz and D. J. Hankinson. Jour. Milk and Food Tech. 16(4). July-August 1953.

853 The influence of some growth regulating substances on pre-harvest drop, drop, color, and maturity of apples. F. W. Southwick, I. E. Demoranville, and J. F. Anderson. Proc. Amer. Soc. Hort. Sci. 61:155-162. 1953.

854 The effect of maturity, apple emanation, waxing, and growth regulators on the respiration and red color development of tomato fruits. F. H. Emmert and F. W. Southwick. Proc. Amer. Soc. Hort. Sci. 63:393-401. June 1954.

856 Effect of organic anions and sugars on phosphate precipitation by iron and aluminum as influenced by pH. D. B. Bradley and D. H. Sieling. Soil Sci. Proc. 76(3):175-179. September 1953.

857 Noncaloric sweeteners in canned fruits. E. E. Anderson, W. B. Esselen, and C. R. Fellers. Jour. Amer. Diet. Assoc. 29(8):770-773, August 1953.

859 More effective fertilizer use needed in the Northeast. M. Drake. Better Crops with Plant Food. 37(8):6-7, 40-43. October 1953.

860 Potassium competition in grass-legume associations as a function of root cation exchange capacity. B. Gray, M. Drake, and W. G. Colby. Soil Sci. Proc. 17 (3):235-239. July 1953.

863 Chemical composition of weeds and accompanying crop plants. J. Vengris, M. Drake, W. G. Colby, and J. A. Bart. Agronomy Jour. 45(5):213-218. May 1953.

864 Cancelled.

865 The effect of maleic hydrazide and water on the rate of respiration of harvested tomato fruits. F. W. Southwick and W. H. Lachman. Proc. Amer. Soc. Hort. Sci. 61:388-394. 1953.

869 Study of a gas heater for producing hot water and steam in the dairy farm milkhouse. W. S. Mueller and W. T. Goenty, Jr. Jour. Milk and Food Tech. 16(4):178-182. July-August 1953.

870 The effects of antibiotics in milk on the human intestinal coliform bacteria. E. I. Stoltz and D. H. Hankinson. Jour. Milk and Food Tech. 17(3):76-78. March 1954.

873 Studies of the creosote fungus, *Hormodendrum resinae*. D. H. Marsden. Mycologia. 46(2):161-183. March-April 1954.

874 Weeding set onions with chloro IPC. W. H. Lachman. Proc. Amer. Soc. Hort. Sci. 61:496-498. 1953.

875 Control for temperature fluctuation. I. J. Pflug and R. J. Misiaszek. Jour. Agr. Eng. 34(9):634. September 1953.

876 The vegetative propagation of Ginkgo. W. L. Doran. Jour. Forestry. 52(3):176-177. March 1954.

877 Fiber diameter in relation to tenderness of beef muscle. R. L. Hiner, O. G. Kankins, H. S. Sloane, C. R. Fellers, and E. E. Anderson. Food Research 18(4):364-376. July-August 1953.

879 Come-up time method of milk pasteurization. D. J. Hankinson, R. B. Read, W. Litsky, and R. R. Brown. Public Health Reports 68(8):769, 770. August 1953.

881 The influence of wind-blown material on the soils of Massachusetts. W. G. Colby, M. A. Light, and T. A. Bertinuson. Soil Sci. Proc. 17(4):395-399. October 1953.

883 Thermal inactivation of pectolytic enzymes used in the clarification of apple juice. G. G. Kohn, W. B. Esselen, and C. R. Fellers. Food Research 18(5):511-515. September-October 1953.

884 Measuring discoloration of food purées in glass tubes. G. E. Livingston and R. J. Vilece. Food Technology 7(7):272-275. July 1953.

886 A study of certain factors affecting fertility in the turkey. J. R. Smyth, Jr. and A. T. Leighton, Jr. Poultry Sci. 32(6):1004-1013. November 1953.

887 A comparison of the most probable numbers of coliform bacteria and enteroccoci in raw sewage. W. Litsky, M. J. Rosenbaum, and R. L. France. Applied Mycology 1(5):247-250. September 1953.

888 Correcting magnesium deficiency in cultivated blueberries. J. S. Bailey and M. Drake. Proc. Amer. Soc. Hort. Sci. 63:95-100. 1954.

890 Effects of storage on Butternut squash and its seeds. A. D. Holmes, A. F. Spelman, and R. T. Wetherbee. Jour. Amer. Dietetic. Assoc. 30(2):138-141. February 1954.

891 A viability study of a frozen Newcastle vaccine for spray application. G. Reising and S. B. Hitchner. Poultry Sci. 33(3):494-499. May 1954.

892 Diets of pregnant women: influence of socio-economic factors. G. H. Murphy and A. W. Wertz. Jour. Amer. Dietetic Assoc. 30(1):34-38. January 1954.

893 Weeds contain valuable chemical compounds. E. Bennett. Agric. and Food Chem. 1(20):1223. December 1953.

894 Action of ozone on water-borne bacteria. J. M. Dickerman, A. O. Castraberti, and J. E. Fuller. Jour. N. E. Waterworks Assoc. 48(1):11-15, January 1954.

895 A comparison of the effects of Terramycin hydrochloride and amphoteric Terramycin on the fecal flora of humans. W. Litsky, S. A. Broitman, and J. R. Cohen. Amer. Jour. Med. Sci. 226: 419-424. October 1953.

896 Germination of seeds removed from mature and immature Butternut squashes after seven months of storage. A. D. Holmes. Proc. Amer. Soc. Hort. Sci. 62:433-436. 1953.

897 The nutritive requirements of Acetobacter. II. The vitamin synthesis of *Acetobacter xylinum*. W. Litsky and C. L. Goldman. Food Research 18(6):646-648. November-December 1953.

898 Results of field tests on spraying a commercially prepared Newcastle disease vaccine. S. B. Hitchner and G. Reising. Proc. Amer. Vet. Med. Assoc. 90:350-355. July 1953.

899 Observations on double-yolked eggs from the domestic fowl. F. P. Jeffrey, T. W. Fox, and J. R. Smyth, Jr. Jour. Heredity 64(5):213-216. September-October 1953.

900 Thermal inactivation of pectolytic enzymes in genuine dill pickles. W. B. Esselen and E. E. Anderson. Food Tech. 8(1):63-64. January 1954.

901 Effect of peroxidase concentration, acidity, and storage temperarture on the development of off-flavors in fresh pack pickles. M. D. Labbee and W. B. Esselen. Food Tech. 8(1):50-54. January 1954.

902 Observations on the thermal resistance of Putrefactive Anaerobe No. 3679 spores in the temperature range of 250-300° F. I. J. Pflug and W. B. Esselen. Food Research 19(1):92-97. January-February 1954.

903 Storage changes in processed applesauce. G. E. Livingston, W. B. Esselen, and C. R. Fellers. Food Tech. 8(2):116-120. February 1954.

904 Factors affecting sex ratio at eight weeks in Rhode Island Reds. F. A. Hays. Poultry Sci. 33(2):230-234. March 1954.

905 Artificial light for activating males and females to higher fertility. F. A. Hays. Poultry Sci. 33(2):321-327. March 1954.

906 The etiology of chronic respiratory disease. H. Van Roekel and O. M. Olesiuk. Proc. Amer. Vet. Med. Assoc. 90:289-302. July 1953.

907 The nutritional requirements of Acetobacter III. Amino acid requirements of *acetobacter xylinum*. B. S. Tepper and W. Litsky. Growth 17:193-199. 1953.

909 The electrophoretic behavior of lignin. E. Bennett. Plant Physiology 29(3):297-298. May 1954.

910 Weed populations as related to certain cultivated crops in the Connecticut River Valley, Mass. J. Vengris. Weeds 2(2):125-134. April 1953.

911 Present status of pullorum disease eradication. H. Van Roekel. Proc. U. S. Livestock Sanitary Assoc. 57:244-248. September 1953.

915 The vegetative propagation of some forest trees. W. L. Doran. Proc. First Northeastern Forest Tree Improvement Conf., Williamstown, Mass. 1954.

916 The influence of nitrogen level on the rate of ripening and color development of apples sprayed with growth regulating substances. F. W. Southwick. Proc. Amer. Soc. Hort. Sci. 63:225-233. June 1954.

917 Composition of Butternut squashes from vines treated with maleic hydrazide. A. D. Holmes, A. F. Spelman, and R. T. Wetherbee. Food Research 19(3):293-297. 1954.

918 The old house borer in Massachusetts. W. B. Becker. Econ. Entomology 47(2):362-363. April 1954.

919 Large leaf spot and canker of peach caused by the fungus *Fusicoccum amygdali* Delacr. E. F. Guba. Plant Disease Reporter 37(11): 560-564. November 1953.

920 Newcastle disease in turkeys—report of a field outbreak. J. E. Gray, G. H. Snoeyenbos, and H. A. Peck. Jour. Amer. Vet. Med. Assoc. 124(925):302-307. April 1954.

921 Design of thermal destruction apparatus. I. J. Pflug and W. B. Esselen. Agri. Eng. 35(4):245-246. April 1954.

923 Conifers by cuttings. W. L. Doran. Nat. Hort. Mag. January 1954. 58-60.

925 Morphological analysis of the maize ear. N. H. Nickerson. Amer. Jour. Botany. 41(2):87-92. February 1954.

926 Effect of warm storage on the bolting of onions grown from sets. (A Preliminary Report.) W. H. Lachman and E. G. Upham. Proc. Amer. Soc. Hort. Sci. 63:342-346. 1954.

929 A simple test of quality in hay. E. Bennett and J. G. Archibald. Jour. Dairy Sci. 37(5):552-555. May 1954.

930 Food Processing. Thermal destruction of microorganisms and enzymes. W. B. Esselen and I. J. Pflug. Presented before the Amer. Assoc. Adv. Sci., Boston, December 29, 1953. The Glass Packer. 33(1):27-29, 53; (2):28-30, 60, 64.

933 Vitamin C. and frozen strawberries. I. S. Fagerson, E. E. Anderson, K. M. Hayes, and C. R. Fellers. Quick Frozen Foods. 26(9): 84-85. April 1954.

934 Possible relationship between the ionic species of glutamate and flavor. I. S. Fagerson. Jour. Agri. Food Chem. 2(9):474-476. April 1954.

935 Effects of soil moisture stress on carbohydrate development and growth in plants. D. H. Woodmans and T. K. Kozlowski. Amer. Jour. Botany. 41(4):316-320. April 1954.

936 Antioxidative properties of cacao and their effect on butteroil. W. S. Mueller. Jour. Dairy Sci. 37(6):754-760. June 1954.

940 Quell separation in pickle relish. E. E. Anderson, A. P. Blank, and W. B. Esselen. Food Eng. 26(4):131, 200, 203. April 1954.

942 A way to combat clubroot. W. L. Doran. Amer. Veg. Grower 2(5):22-23, May 1954.

Miscellaneous

Anderson, E. E., Esselen, W. B., and Fellers, C. R. Taste panel judges non-caloric sweeteners. The Canner 117(22):9-11. November 1953. Reprinted in part from Contribution number 857, Jour. Amer. Dietetic Assoc. 29(8):770-773, August 1953.

Beaumont, A. B. and Thayer, C. H. The field problem in the soils course. Agron. Jour. 45(6). June 1953.

Chandler, F. B. Drainage — A book review. Cranberries 19(3):15, 16. July 1954.

Chandler, F. B. Drainage studies at Massachusetts State Bog. Cranberries 19(3):12. July 1954.

Crossmon, B. D. Research into management problems of corporate farming. Jour. Farm Econ. 35(5). December 1953.

Crossmon, B. D. and Aines, R. O. Exploratory costs and benefits from cooking garbage. *Pork Pointers*, Univ. of Mass. September 1953.

Crossmon, B. D. and Aines, R. O. Will you be shorn with your sheep? *Cackle and Crow*. July 1953: *Worcester County Farmer*. October 1953.

Crossmon, B. D. and Aines, R. O. Is captan three times as good as sulfur? *Fruit Notes*, Univ. of Mass. October 1953.

Crossmon, B. D. and Aines, R. O. Cull cows or buy hay—better do some figuring. *Dairy Digest*, Univ. of Mass. November 1953.

Crossmon, B. D. and Aines, R. O. Greater income vs. more tax. *Fruit Notes*, Univ. of Mass. January 1954.

Crossmon, B. D. and Aines, R. O. Comparative costs of fungicidal and Insecticidal spray materials. Report of 60th Annual Meet. Mass. Fruit Growers Assoc., Inc. January 5-7, 1954.

Crossmon, B. D. and Aines, R. O. Figure your earnings from sheep. American Agriculturist. January 16, 1954.

Crossmon, B. D. and Aines, R. O. Further comment—greater income vs. more tax. *Fruit Notes*, Univ. of Mass. February 1954.

Crossmon, B. D. and Aines, R. O. Pruning hours as well as trees. *Fruit Notes*. Univ. of Mass. March 1954.

Crossmon, B. D. and Aines, R. O. Changes in 1954 green pastures program. *Dairy Digest*, Univ. of Mass. February 1954. Reappeared: New England Homestead. March 27, 1954.

Crossmon, B. D. and Aines, R. O. Do solutions to industry problems fit individual dairymen? Dairy Digest, Univ. of Mass. February 1954. Reappeared: Feed Stuffs. Miller Pub. Co., Minneapolis, Minnesota. April 25, 1954.

Fitzpatrick, R. A. Trends in potato production and sales, 1940-1950. Amer. Potato Jour. 30(7):155-164. July 1953. Reprinted in part from Bulletin number 472, Marketing Massachusetts Potatoes. Part II. The Enterprise in Transition. Mass. Agric. Expt. Station. June 1953.

Gasiorkiewicz, E. C. Chemical soil treatment for the control of Fusarium wilt of carnations. Mass. Flower Growers Bul. 22:3. January 1954.

Gasiorkiewicz, E. C. Effect of temperature on symptom expression of carnation mosaic virus on selected host plants. Phytopath. 44:110. 1954.

Gasiorkiewicz, E. C. Comparative performance of chemical soil treatments for control of Fusarium wilt of carnations. Phytopath. 44:110. 1954.

Guba, E. F. and Ames, R. W. Infectious diseases of carnation. United States Dept. of Agric. Yearbook. 583-592. 1953.

Guba, E. F. Control of Fusicoccum peach canker. Mass. Fruit Growers Assoc. 16:69-70. January 1954.

Guba, E. F. Apple scab and spray injury 1953. Rept. Mass. Fruit Growers Assoc. 16:57-61. 1954.

Hays, F. A. Mortality rate in the laying house and egg production of survivors. Poultry Sci. 32(6):1096-1097. November 1953.

Kozlowski, T. T. The status of research in tree physiology. Jour. Forestry 51:907-908. 1953.

Lachman, W. H. Chemical weed control. N. E. Homestead 127(10):8. May 1954.

Lachman, W. H. Let's grow some sweet corn. N. E. Homestead 127(11):18, 23. June 1954.

Litsky, W., Mallmann, W. L., and Fifield, C. W. A new medium for the detection of enterococci in water. Amer. Jour. Public Health. 43(7):873-879. July 1953.

Marsden, D. H. Dutch cleanser. Industrial Bul. of Arthur D. Little, Inc., No. 299. June 1953.

Marsden, D. H. Effect of drought on shade trees. Trees 14(1):6-7. December 1953. Reprinted by Arboreal Associates, Harriman, N. Y.

Marsden, D. H. Progress in Dutch elm disease control in several towns in Massachusetts. Dutch Elm Disease Conference (Hotel New Yorker). February 4-5, 1954.

McKenzie, M. A. Tornado course in Worcester country projects Dutch Elm disease spread. Mimeo. Report. June 11, 1953.

McKenzie, M. A. Foliage damage by drought. Mimeo. Report. July 23, 1953.

McKenzie, M. A. Tornado tree damage. Trees 13(6):18, 25. September-October 1953.

McKenzie, M. A. Control Dutch elm disease now. Mimeo. Report. November 20, 1953.

McKenzie, M. A. Will spray by helicopter to eradicate Dutch elm disease? The Melrose Free Press. March 25, 1954.

McKenzie, M. A. Pruning and care of shade trees. Home and Grounds Clinic, Pittsfield, Mass. April 5, 1954.

McKenzie, M. A. Three progress reports (the Dutch elm disease). Mimeo. Report. September 1953-June 1954.

McKenzie, M. A. Sycamore blight and other leaf diseases. Mimeo. Circ. June 3, 1954.

McKenzie, M. A. Nine unpublished reports. 1953-1954.

Murphy, Gladys C. *et al.* Subjects' estimation of food intake and calculated nutritive value of the diet. Jour. Amer. Dietetic Assoc. 29(12):1216-1220. December 1953. (Northeastern Regional Nutritional Status Project NE-4.)

Parsons, J. L. and Drake, Mack. Potash pays on forage in New England. Better Crops with Plant Food. 38(6):6-10: 36-38. June-July 1954.

Perriello, R. C., Litsky, W., and Ginsburg, W. Ringworm: A problem for the sanitarian. The Sanitarian 16(4):187-194, January-February 1954.

Read, R. and Litsky, W. Part I. The cultivation of viruses in the embryo egg. Part II. Cultivation of viruses in the embryo egg. Part III. Virus cultivation by animal inoculation. Amer. Jour. Med. Tech. 19(4). July-August 1953; 19(5). September-October 1953; 19(6). November-December 1953.

Sieling, D. H. Organic Matter . . . The key to availability. What's New in Crops and Soils. 6(1):7-10. October 1953. Reprinted in part from Contribution number 810, Soil Sci. 73(3):173-181. March 1952.

Spencer, J. L., Singleton, W. R., and Blakeslee, A. F. Induced pollen lethals from seeds of *Datura stramonium* treated with thermal neutrons. Proc. Nat'l. Acad. Sci. 39:288-292. 1953.

Spencer, J. L. and Blakeslee, A. F. Induced pollen lethals of seeds of *Datura stramonium* exposed to radiation from a nuclear deterioration. Proc. Nat'l. Acad. Sci. 40:397-405. 1954.

Van Roekel, Henry. Salmonellosis in Poultry. The Southwest Veterinarian. 7(1). Fall 1953.

Wertz, A. W., *et al.* A referee blood experiment involving the use of microchemical methods. (Cooperative Nutritional Status Study.) The Journal of Nutrition. Vol. 52 (3):383-393. March 10, 1954.

Publication of This Document Approved by George J. Cronin, State Purchasing Agent.
1M—9-54—913220P